Northern Telecom Limited

Annual Report 1983

Computing technologies for the OPEN World

Northern Telecom Limited
Northern Telecom Limited is the second largest designer and manufacturer of telecommunications equipment in North America. It is the world's largest supplier of fully digital telecommunications systems, and is a significant supplier of integrated office systems. It operates 27 manufacturing plants in Canada, 14 in the United States, one each in the Republic of Ireland, Brazil, and the United Kingdom, and two in Malaysia. Research and development is conducted by 27 R&D centers located at these facilities and by Bell-Northern Research Ltd., a subsidiary, which operates six R&D facilities in Canada and four in the United States, and is the largest industrial research and development organization in Canada.

Contents

2 Report to shareholders
11 Officers and directors
12 Senior management of principal subsidiaries
13 Northern Telecom and principal subsidiaries
14 Computing technologies for the OPEN World
25 Financial review
31 Financial statements
34 Notes to financial statements
42 Eleven-year review
44 Principal products

Form 10-K
The Form 10-K annual report for 1983, as filed by the corporation with the Securities and Exchange Commission in Washington, D.C., is available to shareholders without charge upon request to Richard W. Wertheim, assistant vice-president, investor relations.

Investor information
Investors desiring information about Northern Telecom's operations should write to the investor relations department at the corporation's executive offices, or telephone: (416) 275-0960.

Annual Meeting
The annual meeting of shareholders will take place at 11:00 a.m., Thursday, April 26, 1984 in Le Château Champlain, Montreal, Quebec.

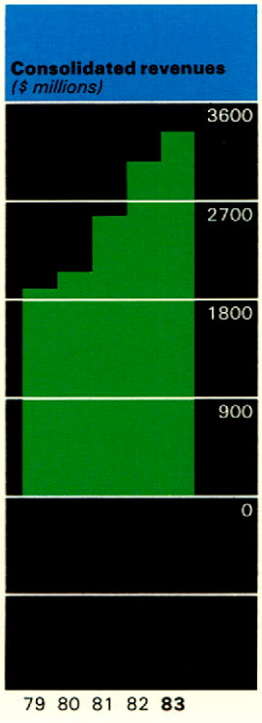
Version française
On peut obtenir la version française de ce rapport en écrivant à l'adresse suivante:
Service des relations de l'entreprise
Northern Telecom Limitée
C.P. 458, succursale A
Mississauga (Ontario)
Canada L5A 3A2

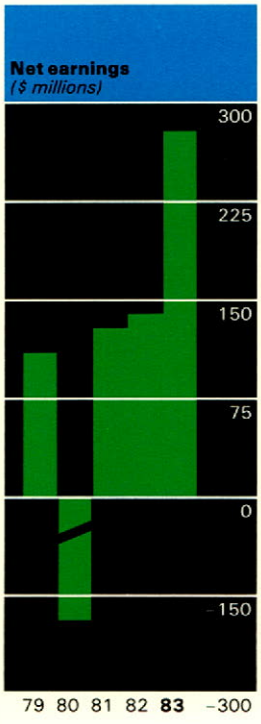
Versión española
Puede obtenerse la versión española de este informe solicitándola al
Corporate Relations Department
Northern Telecom Limited
P.O. Box 458, Station A
Mississauga, Ontario
Canada L5A 3A2

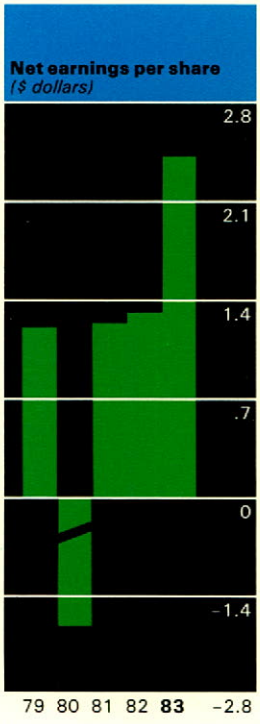
Cover
For the past two decades, Northern Telecom and Bell-Northern Research (BNR) have been designing computers for increasingly sophisticated and cost-effective telecommunications systems. Douglas MacKinnon, of BNR's scientific staff, uses an advanced computer terminal to design complex, multi-layer printed circuit boards for Northern Telecom's fully digital switching and transmission systems.

Financial highlights

	1983	1982
Revenues	**$3,304,043,000**	$3,035,511,000
Net earnings	**268,410,000**	139,412,000
Net earnings per share	**2.42**	1.32
Dividends per share	**0.40**	0.333
Shareholders' equity	**1,465,577,000**	1,005,467,000
Working capital	**701,480,000**	636,106,000
Capital expenditures	**376,905,000**	252,635,000
Research and development expenditures (net)	**324,824,000**	241,407,000
Shares outstanding (at December 31)	**114,607,222**	106,352,286
Shares outstanding (average during year)	**110,926,011**	105,492,399
Shareholders	**13,536**	9,872
Employees	**39,318**	34,449







HOWARD ROSS LIBRARY OF MANAGEMENT
APR 6 1984
McGILL UNIVERSITY

Report to shareholders

In 1983 Northern Telecom continued to strengthen its position as the world's leading supplier of fully digital telecommunications systems.

At yearend, Northern Telecom had sold, or on order, fully digital DMS switching and transmission systems and SL PBXs (private branch exchanges) to serve the equivalent of 16.2 million telephone lines in 60 countries.

Northern Telecom shipped 3.7 million equivalent lines of DMS switching, including about 375 switches, or more than one every working day in 1983. In 1984, the corporation expects to ship about 600 DMS switches globally, representing the equivalent of about five million lines. Shipments in the first half of the year will be at the rate of two per working day, increasing to three switches per working day in the latter part of the year.

In the first year since its November 1982 announcement of the OPEN World, the corporation introduced a stream of products and features, and continued the evolution and enrichment of its established systems such as the SL-1 PBX.

OPEN (Open Protocol Enhanced Networks) World is Northern Telecom's approach to serving the needs of people and organizations for more effective information management.

Under the OPEN World program, Northern Telecom committed to the evolution of the SL and DMS switching systems to serve as controllers for office information systems. These controllers will link Northern Telecom's currently available terminals and systems and those announced for introduction during the 1983-through-1987 period, with products of other vendors. These networks will be able to handle the efficient communication and use of information in all forms—voice, data, image, and graphics.

During 1983, Northern Telecom again took advantage of its growing financial strength to raise the annual investment rate and amount of its spending for research and development, plant and equipment, and the recruitment and training of people.

Reflecting the success of prior years' investments in these key areas, Northern Telecom's consolidated revenues, net earnings and earnings per share (before extraordinary gains), order input and yearend backlog were all at record levels in 1983.

Earnings up 72 percent

As it forecast, Northern Telecom achieved a substantial gain in net earnings in 1983 while recording only modest growth in consolidated revenues.

Consolidated revenues rose 8.8 percent to $3.304 billion, compared with $3.036 billion in 1982. Net earnings, before extraordinary gains in both years, rose 71.5 percent to $227.1 million ($2.05 per share), compared with $132.4 million ($1.26 per share).

Net earnings for 1982 were restated from the previously reported figures to conform with a new policy on foreign currency translation, recommended by The Canadian Institute of Chartered Accountants. There are now no reportable differences affecting the financial results between Canadian and U.S. generally accepted accounting principles. Earnings per share figures reflect a three-for-one split of the common shares, effective May 11.

Extraordinary gains of $41.3 million ($0.37 per share) in 1983, and $7 million ($0.06 per share) in 1982, brought net earnings to $268.4 million ($2.42 per share) and $139.4 million ($1.32 per share), respectively. The extraordinary gains resulted from the use of prior years' tax losses of a U.S. subsidiary. These tax loss carryforwards were fully used in 1983.

The substantial improvement in net earnings from the previous record-1982 performance is mainly attributable to the increased revenues and profitability of the DMS central office switching product line and the improved performance of the U.S. Integrated Office Systems (IOS) organization.

IOS was created in 1982 to serve the market for office products, systems, and networks, ranging from basic voice terminals to multi-featured, integrated information workstations. The U.S. part of the former Electronic Office Systems (EOS) organization was among the businesses absorbed by IOS. In 1982, the global EOS organization recorded a substantial operating loss, due, in part, to the costs of measures implemented to improve its performance.

It is no longer possible to report on the performance of the former EOS business on a comparative basis. However, based on internal estimates and cost assumptions, it was apparent that these operations achieved substantial financial improvement during 1983 and by yearend were breaking even or were marginally profitable. This improvement was a major contributor to the profitability of IOS.

Canadian revenues down 14 percent; U.S. up 27 percent

The modest increase in 1983 revenues was largely caused by weakness in the Canadian market. Entering 1983, we anticipated a 14 percent decline in the capital spending of the telephone companies in Canada. In fact, they cut their spending by an estimated 19 percent to $2.337 billion, from an already depressed 1982 investment level.

Consequently, the corporation's revenues in Canada declined 14.1 percent to $1.072 billion in 1983 from $1.248 billion in 1982. Canada accounted for 32.4 percent of consolidated revenues in 1983 compared with 41.1 percent in 1982. Sales to Bell Canada declined to $738.7 million, or 22.4 percent of total revenues, compared with $845.9 million (27.9 percent of revenues) in 1982.

The impact on Canadian earnings was not as severe as the drop in revenues. Some operations even increased their profitability. This was achieved through cost-reduction and productivity-improvement measures taken in 1982 and 1983, and the use of available manufacturing capacity to meet increasing international demand.

Employment in Canadian operations rose 12.3 percent in 1983 to 21,303 people. The increase was possible, despite the decline in revenues, because of the increasing number of jobs supported by Northern Telecom's growing international business. This includes manufacturing and support-related jobs for exports, and R&D operations, including those of Bell-Northern Research (BNR), the corporation's R&D subsidiary. In addition, some locations increased employment anticipating improved growth in 1984.

Outside of North America, Northern Telecom's revenues were up 15.7 percent in 1983 to $376.3 million, compared with $325.2 million in 1982, accounting for 11.4 percent and 10.7 percent of consolidated revenues, respectively. International operations increased employment by 9.6 percent to 2,311 people at yearend 1983. A larger increase is planned for 1984 as the corporation continues to place more emphasis on international markets.

In October, the corporation announced it is establishing a new company in the United Kingdom, called Northern Telecom plc. This company will consolidate and expand U.K. marketing, manufacturing, and R&D in telecommunications and data systems.

Formation of the new company represents an immediate capital investment of nearly $13 million. Manufacturing is being centered in a new 100,000-square-foot plant in Hemel Hempstead. A product development center also is being established there to create new terminal systems and to configure Northern Telecom's computer systems for European customers. Some 100 engineers, designers, technicians, and manufacturing personnel are being hired to support the expanded data-systems operations.

Additionally, a BNR laboratory is being established near Maidenhead. This facility will initially employ 70 engineers, scientists, and support staff. Northern Telecom currently employs more than 330 people in the U.K. The expansion of the U.K. operations is being undertaken in recognition of the opportunities inherent in the apparent opening of the U.K. telecommunications market to competitive products and technologies.

Employment in Northern Telecom's U.S. operations rose 17.4 percent in 1983 to 15,704 people as revenues in the country were up 26.9 percent to $1.856 billion from $1.462 billion in 1982. This marks the first time that U.S. revenues accounted for more than half, 56.2 percent, of the corporation's annual consolidated revenues. In 1982, they represented 48.2 percent of the total.

The dynamic U.S. environment comprises multiple growing markets for telecommunications equipment. Northern Telecom is increasing its sales in each of these markets, including to the telephone companies; resale and other common carriers; financial, education, health-care, hospitality and other businesses and institutions; and military and government. Product lines making the largest contributions to the growth in the U.S. were the DMS central office switches (including the DMS-250 tandem switch), up 82.3 percent; SL-1 and SL-100 digital PBXs, up 15.5 percent; and transmission equipment, which rose 67.9 percent.

The financial review, beginning on page 25, provides a more detailed discussion of the corporation's 1983 results compared with those of prior years.

DMS: The world leader

The U.S. accounted for about 76 percent of the $962.4 million in DMS switching revenues in 1983, up 43.1 percent from the $672.5 million recorded in 1982, when the U.S. accounted for about 60 percent of the total.

Since the 1977 introduction of the small DMS-10 local switch, the world's first fully digital central office switching system, Northern Telecom's cumulative DMS switching revenues total more than $2.6 billion.

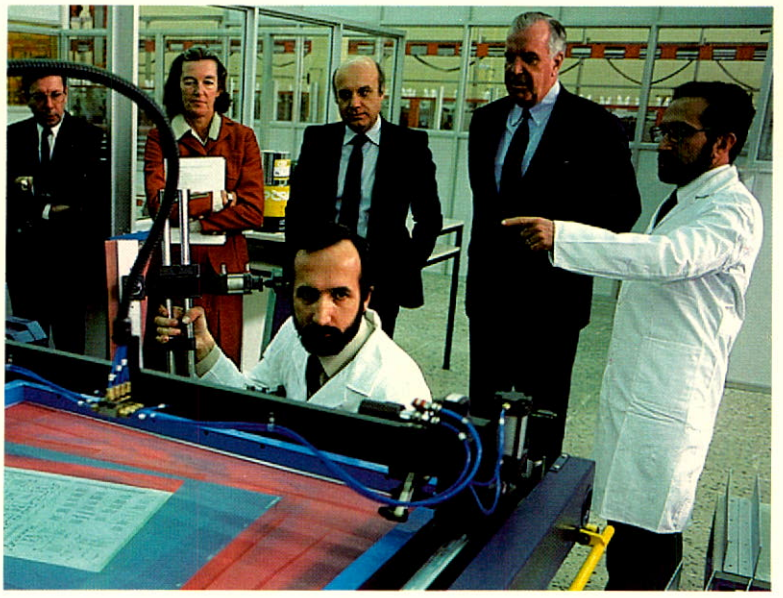
The most significant growth in DMS sales is to the Bell operating companies (BOCs) in the U.S. In 1979, following an extensive evaluation of digital switches from the principal international manufacturers of such systems, American Telephone and Telegraph (AT&T) recommended Northern Telecom's DMS-10 for use by its operating companies. This was the first time AT&T had recommended a switch designed and built by an outside supplier. In February 1980, Northern Telecom and AT&T signed a supply agreement for the DMS-10.

Following other evaluation studies, AT&T subsequently chose, and signed supply contracts with Northern Telecom for: the DMS-1 subscriber carrier system, DMS-100 large local switch, DMS-200 long-distance system, and DMS-100/200 local and long-distance combined switch.

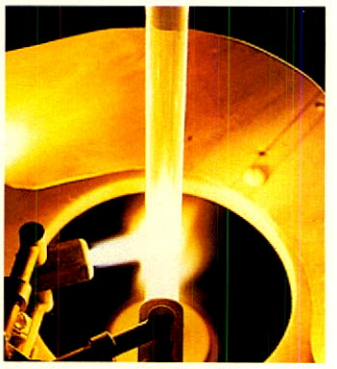
In 1983, the corporation's U.S. subsidiary, Northern Telecom Inc. (NTI), signed supply contracts, each worth an estimated US$60 million to more than US$200 million over the first two years, with the New England Telephone, Southwestern Bell, Southern Bell, and South Central Bell operating companies, and U.S. West, one of seven regional holding companies created with the divestiture of the BOCs by AT&T, effective January 1984. Previously, in 1982, NTI signed a similar supply contract with New York Telephone. In January 1984, NTI signed a DMS supply contract for 46 months with a subsidiary of Ameritech, another of the new regional Bell holding companies. With the signing of this agreement, NTI has DMS supply agreements covering the operating companies in five of the seven holding companies. Negotiations are well advanced on agreements to cover the remaining two holding companies; in the meanwhile, their operating companies continue to buy DMS switches. NTI has sold to, or received orders from, 21 of the 22 BOCs for DMS switches.

In addition, NTI signed supply agreements with three regional Bell holding companies, Pacific Telesis, Southwestern Bell, and Bellsouth, for the supply of SL digital PBXs.

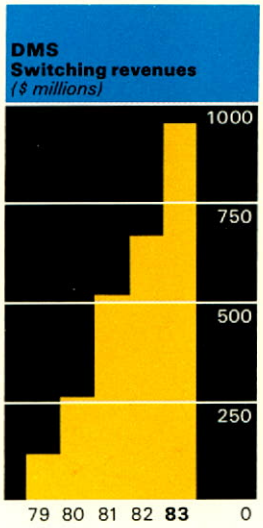
Northern Telecom's sales to the U.S. Bell System have grown rapidly. In 1983, total sales to the Bell System were about US$340 million, more than double the US$161 million in 1982, and compared with US$101 million in 1981. DMS has represented a growing proportion of these sales, which also include transmission, cable and outside plant, telephones, test equipment, and other products.

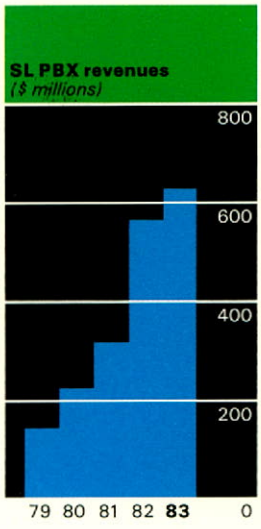


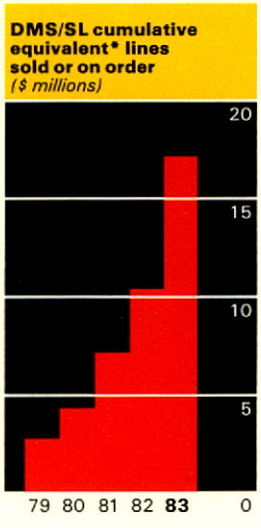
Northern Telecom's president, Edmund B. Fitzgerald (second from right), is shown part of the printed circuit board production process at the NETAS plant near Istanbul, Turkey.



In the production of glass fiber for single-mode optical systems, an oxygen-hydrogen flame travels the length of a quartz tube, causing the gaseous chemicals to react and be deposited on the inner walls at the point of heat.







*Includes long-distance trunks multiplied by five

DMS switching revenues to the BOCs amounted to US$254 million in 1983, nearly quadrupling the US$66 million recorded in 1982. At yearend 1983, Northern Telecom had installed 163 DMS-10s and 27 DMS-100 Family switches for the BOCs, and had firm orders for an additional 33 DMS-10s and 110 DMS-100 Family switches, worth approximately US$270 million. The total revenues anticipated under the existing contracts are expected to be much greater over the next several years.

NTI also signed a supply contract with United Telephone System. The contract, which is expected to be worth more than US$100 million over three years beginning in 1984, covers the DMS-10 and new compact DMS-10M, and the DMS-100 Family, including the new DMS MTX cellular mobile-radio telephone switching system, DMS-200 Autovon military switch, and the DMS-300 international communications switch.

Northern Telecom entered the cellular mobile-radio telephone equipment market in 1983 in partnership with the General Electric Company. Northern Telecom will provide the switches and cell site controllers, and General Electric the 800 megahertz radios. The DMS MTX can serve up to 50,000 mobile-telephone subscribers, and a smaller version, the DMS MTXC, can economically provide service to 30,000 users.

Customers who have previously installed DMS switches can add cellular capability to them. The companies will also provide systems engineering and consultation services for establishing and maintaining cellular radio networks. A trial system is currently operating in Jacksonville, Florida with commercial shipments expected in early 1984. Northern Telecom has received orders for DMS MTX systems from U.S. West for four major U.S. cities, and from Bell Canada. It is negotiating several other contracts.

In Canada, a highlight was the signing of a five-year supply agreement by Northern Telecom Canada Limited and Teleglobe Canada for the installation and expansion of DMS-300 exchanges in Vancouver, British Columbia; Toronto, Ontario; and Montreal, Quebec. The agreement is estimated to be worth $70 million or more, including the first major purchase, a $12 million DMS-300. Teleglobe owns and operates an extensive network that provides Canada with a full range of international telecommunications services. The installation of these DMS-300s will make all of Canada's international telecommunications digital by 1986.

DMS is a growing factor in Northern Telecom's international success.

In the Caribbean, for example, DMS switches have been installed, or ordered, by the telephone companies in Puerto Rico, Barbados, Grenada, Antigua, the Bahamas (Freeport and Nassau), Jamaica, Haiti, St. Christopher and Nevis, and Trinidad and Tobago.

Barbados placed in service, in August, Northern Telecom's first fiber optics network outside of North America, connecting it to a DMS-100.

Northern Telecom successfully completed a contract worth more than $60 million to expand and upgrade Trinidad and Tobago's telephone network with digital systems. Bell Canada International, under a sub-contract, played a valuable role in the program, including the training of Trinidad & Tobago Telephone Company personnel. The Trinidad and Tobago company subsequently informed Northern Telecom that, following the evaluation of bids for the second phase of its program, it has awarded the project to the corporation.

In April, Bermuda put in service a DMS-100, a DMS-100/200 (including the two millionth local DMS-100 line globally), a number of remote line modules, and 20 TOPS (Traffic Operator Position System), linked by Northern Telecom's digital transmission equipment.

In Peru, the domestic telephone company put in service in November, its first digital switch, a DMS-10. This is Northern Telecom's first DMS central office in South America.

In August 1981, the Austrian government announced it had chosen Northern Telecom's DMS-100 local and DMS-200 long-distance switching systems' technology to serve as the basis for equipment to be used to meet much of the future expansion and modernization requirements of the country's network. The technology was to be used for digital switches to be developed and produced by Kapsch AG and Schrack Electronik AG, leading Austrian electronics and telecommunications systems manufacturers, under licensing agreements, and in cooperation, with Northern Telecom.

The program progressed well during the next two years and the first DMS-based Austrian switch was put in operation in late 1983.

Northern Telecom signed its largest single contract for DMS switching in August when an agreement was reached with the Post, Telegraph and Telephone (PTT) Administration of the Republic of Turkey to supply more than $300 million worth of DMS switches and components over five years, beginning in 1984. These switches, like those in Austria, meet international telecommunications standards. The contract was signed subject to the provision of financing to Turkey by Canada's Export Development Corporation (EDC).

Following the initial shipment of three complete DMS-100 and two DMS-200 switches, Northern Telecom will supply components for the production of the equivalent of two million lines of digital switching, and of TOPS, telephone sets, and power equipment by Northern Electric Telekomünikasyon A.S. (NETAS), a Turkish manufacturing company that is 31 percent-owned by Northern Telecom. NETAS also will be able to produce DMS switches for international markets under a license.

Earlier in 1983, Northern Telecom signed another agreement with the PTT for the supply through 1984 of $130 million of analog switching parts and components. At yearend 1983, only $59 million in orders under these two contracts worth more than $430 million, were included in Northern Telecom's backlog.

Northern Telecom is particularly proud of its relationship with Turkey which began in 1967. It has benefitted all the concerned parties. During the past 16 years, the joint venture has grown to employ more than 2,000 people, of which just three are Canadian, and the Turkish PTT has expanded to provide an additional 5,000 jobs. NETAS now operates one of the largest R&D facilities in that country.

During the past 16 years, Northern Telecom's Canadian plants have exported to Turkey nearly $300 million worth of analog telephone switching systems, parts and components, and services, supporting hundreds of jobs. The new five-year contract for digital equipment is expected to provide about 12,000-person-years employment in Northern Telecom's Canadian facilities, in those of its 1,500 suppliers, and in the economy in general.

Late in 1983, Nippon Telephone & Telegraph (NTT), Japan's telecommunications authority, announced that, following a competitive international tender, it is awarding a contract to Northern Telecom to supply a mobile DMS-10 for emergency telecommunications service. This will make Northern Telecom the first non-Japanese manufacturer to supply a digital central office switch to NTT.

NTT also granted type approval to the SL-1, the proprietary electronic key telephone set, and the Add-on Data Module which permits data to be transmitted and switched through the PBX. In January 1984, the Union Bank of Switzerland put the first SL-1 in service in Japan in Tokyo.

SL-1/SL-100: Staying ahead in digital PBXs

Northern Telecom has sold, or on order, SL-1 and SL-100 systems to serve the equivalent of more than three million telephone lines in 46 countries. Cumulative SL-1 revenues globally are about $1.9 billion, including $570 million in 1983, a 17.8 percent increase from $484 million in 1982. SL-100 added $58 million in PBX revenues in 1983 and $87 million in 1982. In 1983, Northern Telecom shipped 819,000 lines of SL-1 and SL-100 PBXs, up 21 percent from 1982. The SL PBXs, which can handle cost-effectively an organization's requirements for 30-to-30,000 communications lines, are the best-selling digital PBXs in the world.

Northern Telecom, as a part of its OPEN World program, is committed to the continuous evolution and enrichment of SL-1 and SL-100 to ensure that they offer greater, proven reliability and comparable, or better, capability to those of any competing PBXs available from other manufacturers.

Consistent with the OPEN World criterion of product design continuity, the corporation is capable of upgrading any SL PBX previously installed to offer the same feature capabilities and performance standards as the newest systems being shipped.

In 1983, under the OPEN World program, Northern Telecom made a number of announcements and introductions of new capabilities for the SL PBXs.

OPEN World: Meeting our commitments

In December 1983, Northern Telecom began shipments of the SL-1S, the newest and smallest member of the SL Family, designed to meet business requirements for a 30-to-120-line system. The future availability of very-high-density line cards will make the system expandable to 160 lines in the same cabinet.

In March 1984, Northern Telecom will begin shipping the SL-1N and SL-1XN. These systems represent the evolution of several previously available models. Employing new components technology and redesigned circuitry, they will be as small as one third the size of their predecessors, while offering substantially greater capacity.

SL-1N will be capable of serving up to 840 lines in a totally non-blocking configuration (you don't get a busy signal due to tie-up within the PBX), and 1,500 lines in total; the SL-1XN can serve up to 3,000 lines in a non-blocking design and 5,000 lines overall. The SL-1M, introduced in 1982, continues to be available for requirements up to 300 lines.

The systems and feature capabilities announced significantly expand the integrated voice and data capabilities of SL-1. Among the enhancements announced were:

- A feature permitting most ASCII asynchronous terminals to operate as IBM 3270-type on-line systems.
- An IBM 3278 coaxial-cable displacement link, enabling on-line terminals to gain access to multiple host computers over twisted-pair telephone wiring through the SL-1 at speeds up to 56,000 bits of information per second.
- An IBM personal computer (PC) and PC XT interface line card, which permits the efficient connection of these systems over standard telephone wires through the SL-1.
- An integrated voice messaging system able to receive, store, and play back voice messages without the services of an attendant.
- A computer-to-PBX interface (CPI) specification for more effectively connecting PBXs and computers, announced in July with Digital Equipment Corporation (DEC), the second largest supplier of computer systems in the world.
- A Digital Trunk Interface that will permit the transmission of data through the SL-1 and outside without requiring analog modems.
- An Asynchronous Interface Module (AIM), available since mid-1983, permits data to be sent through the SL-1 asynchronously, without the use of SL-1 telephone sets, at speeds from 110-to-19,200 bits per second.
- An SL-1 Displayphone. The SL-1 Displayphone offers the same capabilities as the Displayphone introduced in 1982. Displayphone was the world's first integrated voice and data display terminal. SL-1 Displayphone is fully integrated with the PBX to provide an expanded array of voice and data features. A coaxial cable adapter, introduced for Displayphone, enables the terminal to be connected to an IBM 3270 computer, emulating an IBM 3278-2 terminal, but capable of operating over twisted-pair wiring through SL-1.

OPEN World included five key criteria for evaluating the effectiveness of information management systems. These criteria—the five Cs—are Control, Cost-effectiveness, Congeniality, Continuity, and Compatibility.

Compatibility requires that an effective information system be capable of linking diverse products and systems from many different manufacturers. A number of the enhancements described will contribute to making the SL PBXs compatible with other systems. In addition, Northern Telecom has reached agreements with other companies to work together to enhance the connectivity of their systems with Northern Telecom's and to cooperate in other areas. Northern Telecom signed such agreements in 1982 with DEC and Sperry Univac. In 1983, agreements were signed with the Hewlett-Packard, Data General, and Wang corporations, and others are being negotiated.

The effectiveness of another member of the SL Family, the SL-10 data packet switch, is being enhanced with the introduction in 1984 of a remote protocol converter and concentrator, fully integrated with the SL-10 system. Called RAPID (Remote Access Programmable Interface Device), it will extend economically the capabilities of SL-10 networks to users removed from central switches.

SL-10s are in service, or on order, for public and private networks in 10 countries. Among several significant contracts signed for SL-10s in 1983, one of particular note is the corporation's first for packet switches with a BOC. Under an initial US$5.5 million contract with Southern Bell, Northern Telecom will supply and install six SL-10s and up to 20 RAPIDs as part of Southern Bell's Local Area Data Transport public data communications network, expected to be operational in May 1984.

The SL and DMS switches are examples of Northern Telecom's 20 years of experience in designing and manufacturing sophisticated, powerful computers. These capabilities are now being extended to evolve these systems and to produce new processors, workstations, and other office information systems as a part of the OPEN World program. Northern Telecom's past and current efforts in computing technologies are discussed in "Computing Technologies for the OPEN World," beginning on page 14.

Productive R&D investment

Northern Telecom's increasing annual investments in R&D have been highly productive. In addition to the evolution of the DMS and SL systems, Northern Telecom introduced many other products during 1983, including test, cable and outside plant, and transmission systems, and telephone sets.

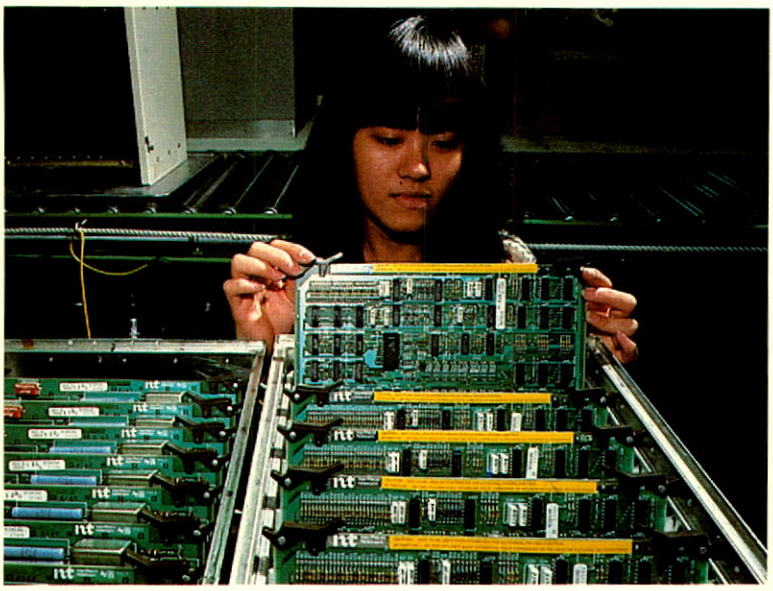
In October, for example, the corporation announced a new line of advanced electronic telephones, called the 8000 series. The first set available is called Harmony. Harmony employs three custom-designed and manufactured integrated circuits and other components to produce an electronic, push-button residential telephone that reduces the parts and raw materials in a set by half, and that takes only 10 minutes to manufacture compared with 30 minutes for previous telephones.

Shipments to MCI Communications began of the corporation's new RD-4A four gigahertz digital microwave radio and single-mode fiber optics cable.

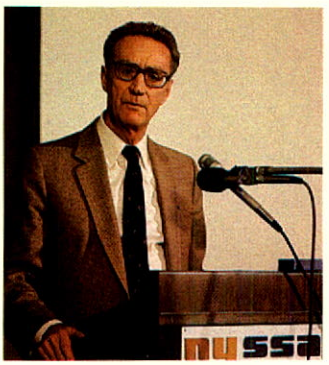
NTI formed a new division called Memory Systems, located in Ann Arbor, Michigan, to design and manufacture a family of high-capacity, high-performance disk and tape drives for data-processing systems. The first of these were supplied for evaluation to a number of companies in 1983 and are being used in Northern Telecom's systems.

IOS began shipments of the Model 565 office information system, which can handle from one-to-four terminals for data processing requirements. The Model 565 and larger Model 585 systems are able to use a new electronic mail system called Omnimail, and, together with the Model 445 system, can now offer personal computing capability.

In late 1983, the Vantage 48 electronic key telephone system was launched, expanding the Vantage family's feature capabilities and capacity to serve as many as 48 telephones.



Irene Wong prepares printed circuit packs for Vantage electronic key telephone systems produced at the business products plant in Calgary, Alberta.



In December 1983, Northern Telecom's chairman and chief executive officer, Walter F. Light, discussed the corporation's targets through 1988 with the New York Society of Security Analysts.

Investing in the future

Northern Telecom must remain an innovative, low-cost, high-quality producer to extend its leadership in increasingly competitive markets throughout the world. Accordingly, we have steadily increased investments in R&D, capital projects, and human resources.

Net R&D spending in 1983 amounted to $324.8 million, an increase of 34.5 percent from the 1982 level of $241.4 million. This is an investment rate of 9.8 percent of consolidated revenues, up from eight percent in 1982.

Capital expenditures for plant and equipment, and additions to the lease base, reached $376.9 million in 1983, up 49.2 percent from $252.6 million in 1982. Major projects included: a new laboratory building for BNR in Ottawa, Ontario, which is now being occupied; a new BNR laboratory in Edmonton, Alberta; an electronic key telephone manufacturing plant in Calgary, Alberta; initial planning for a new NTI headquarters building in Nashville, Tennessee; expanded manufacturing capacity for DMS and SL switching systems in Raleigh, N.C. and Santa Clara, California, respectively, and for fiber optics in Saskatoon, Saskatchewan. Additional investments were made for manufacturing start-ups for the new product lines.

Northern Telecom also continued to spend heavily on cost-reduction and productivity improvement equipment and manufacturing processes. These included computerized design and test equipment, and robotics and computerized integrated manufacturing systems.

During the year, preparing for revenues growth, the corporation added 4,869 people. At yearend 1983, Northern Telecom employed 39,318 people. While expenses rose somewhat as a result, we view this as an essential investment in the future.

The progress accomplished in 1983 derives from the dedicated performance of people throughout the corporation, making their individual and collective contributions to Northern Telecom's success. The Board of Directors takes this opportunity to acknowledge their efforts with appreciation.

Several changes occurred in 1983 at executive and Board levels in the corporation.

Two new members joined Northern Telecom's Board of Directors: Paul F. Oreffice, 56, president and chief executive officer, The Dow Chemical Company, Midland, Michigan, and Donald J. Schuenke, 55, president and chief executive officer, The Northwestern Mutual Life Insurance Company, Milwaukee, Wisconsin.

Georges L. Demers, Q.C., a partner of Demers, Gosselin and Robitaille, Quebec City, Quebec, retired from the Board in April. His 16 years of service are noted with gratitude.

Within Northern Telecom management, Donald A. Noble, 50, was appointed executive vice-president, finance and administration, after seven years in senior management roles with the corporation and nearly 20 years with Bell Canada. Mr. Noble succeeded Robert A. Ferchat, who was appointed president of Northern Telecom International Limited (NTIL) following the retirement of William T. Simpson, NTIL's first president when it was established in 1977. Mr. Simpson served Northern Telecom in various capacities for 38 years and his contributions will be missed.

George W. Sullivan, 51, formerly executive vice-president, federal systems and international for NTI, was appointed president of Nashville, Tennessee-based Northern Telecom International Inc., reporting to Mr. Ferchat.

Walter C. Benger, 57, the corporation's executive vice-president, marketing, with 36 years experience at Northern Telecom, will serve as managing director of Northern Telecom plc, also reporting to Mr. Ferchat. Although resident in the U.K., he will continue to function as executive vice-president, marketing, Northern Telecom Limited.

Targets and strategies for growth

The next five years to 1988 represent a period of great opportunity and challenge. While we feel that Northern Telecom is in the best position of any North American manufacturer to benefit from the restructuring of the Bell System in the U.S., competition is increasing from international companies in Europe and Asia. The pace of technological progress continues to accelerate. Regulatory and legislative actions which affect our customers and markets occur with increasing frequency throughout the world. Continuing world economic recovery seems likely, but is not assured.

It is, therefore, difficult to forecast. However, the corporation has established financial targets and strategies through 1988 that we regard as appropriate and achievable.

In 1984, our revenues growth target is to achieve a better than 25 percent increase to more than $4 billion. Northern Telecom ended 1983 with the highest order backlog for any quarter in its history, $1.529 billion, up 30.3 percent from the yearend 1982 level. Order input in 1983 was a record $3.48 billion.

Pre-tax earnings in 1984 should grow somewhat faster than revenues, but earnings per share are expected to grow at a comparable rate, reflecting an anticipated increase in our corporate tax rate. We expect that, as in 1983, the corporation's second-half performance will be somewhat stronger than in the first six months. Some increase in Canadian business in 1984 is anticipated, but the Canadian telephone companies probably will increase their capital spending only about nine percent from the depressed 1983 level.

The corporation's most significant gains will continue to be in the U.S. Sales to the BOCs should well exceed US$500 million dollars in 1984, while sales to other sectors of the market will also increase. We expect the U.S. to account for more than 60 percent of total consolidated revenues in 1984; Canada for about 25 percent; and international for 10-to-15 percent.

Northern Telecom's investment rate in R&D in 1984 will remain at approximately the current level of 9.5-to-10 percent. We are budgetting an investment of about $400 million. Capital spending again will increase significantly to about $500 million. Among major capital projects are: digital switching expansion in the U.S. and Canada; expansion of the corporation's custom-semiconductor manufacturing capacity; continued investment in computerized systems and robotics.

Northern Telecom's five-year target is to achieve a compound annual rate of revenues growth of about 20 percent. We may actually hit or exceed the $5 billion mark for 1985, and, if we achieve our long-term target, we would exceed $8 billion in revenues in 1988.

Geographically, our international business should grow most quickly over these years, exceeding the $1.2 billion level in 1988, and would continue to account for about 15 percent of the business. We anticipate that the U.S. will represent about two thirds of our business in 1988, and Canada about 20 percent.

The corporation's target is to increase the return on revenues, before any extraordinary items, from 6.9 percent in 1983 and the seven-to-eight percent level expected in 1984, to at least eight-to-nine percent in 1988.

During the period, annual investment in R&D will continue at a rate of between 9.5-and-10 percent of consolidated revenues. During the past five years, we invested just over $1 billion in R&D. In the next five years, our R&D investment will amount to another $3 billion.

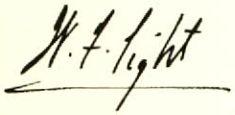
We believe that a ratio of total debt to total capitalization under 30 percent is a comfortable level. Our total debt was 11 percent of capitalization at yearend 1983.

Northern Telecom has maintained dividends within a payout ratio of about 20-to-25 percent of trailing 12-months net earnings, before extraordinary gains. However, we believe it may be more beneficial to our shareholders for us to re-invest an increasing proportion of our profits. Therefore, the corporation may permit the payout ratio to decline by maintaining the current dividend in 1984.

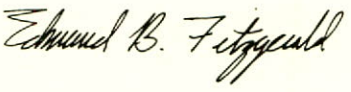
For 1988, the corporation has targetted a return on average shareholders' equity of 20 percent or better, compared with 18.4 percent in 1983, and a net return on average invested capital of 15-to-18 percent, compared with 12.3 percent in 1983.

We will continue to emphasize the need to attract, develop, and retain the best people. We expect that the corporation's employment will exceed 55,000 in 1988.

Our strategy is to continue to extend the international recognition Northern Telecom has won as a leader in the development, manufacture, supply, and service of advanced, integrated telecommunications products and systems.



Walter F. Light
Chairman and Chief Executive Officer



Edmund B. Fitzgerald
President

February 3, 1984

Officers

Chairman of the Board and Chief Executive Officer
Walter F. Light

President
Edmund B. Fitzgerald

Vice-chairman of the Board
Basil A. Beneteau

Executive vice-presidents
Walter C. Benger
Marketing

Donald A. Chisholm
Technology and innovation

Charles G. Millar
Operations

Donald A. Noble
Finance and administration

Senior vice-presidents
Clive V. Allen
General counsel

Roy T. Cottier
Corporate relations

J. Derek M. Davies
Business development

C. Denis Hall
Technology

Vice-presidents
Philip T. Erickson
Patents and licenses

John D. MacDonald
Operations, manufacturing

R. Brian O'Regan
Public affairs

Thomas A. Payette
Taxation

Edward J. Pillman
Business systems

John J. Rankin
Human resources

Vice-president and treasurer
David W. Kendall, Jr.

Controller
Stephen A. Holinski

Secretary
Anthony J. Lafleur

Directors

Ian A. Barclay [3,5]
Chairman of the Board
British Columbia Forest Products Limited
Vancouver, British Columbia

William O. Beers [1,6]
Former Chairman of the Board and Chief Executive Officer
Kraft, Inc.
Chicago, Illinois

Basil A. Beneteau [5]
Vice-chairman of the Board
Northern Telecom Limited

A. Jean de Grandpré, O.C., Q.C. [2,3,6]
Chairman of the Board, President and Chief Executive Officer
Bell Canada Enterprises Inc.
Montreal, Quebec

Edmund B. Fitzgerald [2,4,5,6,7]
President
Northern Telecom Limited

Donald S. Harvie, O.C. [1,4]
Chairman
Devonian Group
Calgary, Alberta

Robert S. Hurlbut [1,2,4]
Chairman of the Board and President
General Foods Inc.
Toronto, Ontario

James W. Kerr [3,5]
Former Chairman of the Board and Chief Executive Officer
TransCanada PipeLines Limited
Toronto, Ontario

Walter F. Light [2]
Chairman of the Board and Chief Executive Officer
Northern Telecom Limited

Clifford S. Malone [1,2,4]
Vice-chairman
United Corporations Limited
Toronto, Ontario

John H. Moore [1,2,5]
Chairman of the Executive Committee of the Board
London Life Insurance Company
London, Ontario

William L. Naumann [3,6]
Former Chairman of the Board and Chief Executive Officer
Caterpillar Tractor Co.
Peoria, Illinois

Paul F. Oreffice [6,7]
President and Chief Executive Officer
The Dow Chemical Company
Midland, Illinois

Charles Perrault [3,5,7]
President
Perconsult Ltée.
Montreal, Quebec

Gérard Plourde, O.C. [2,4]
Chairman of the Board
U A P Inc.
Montreal, Quebec

Walter M. Robinson, Jr. [1,6]
Partner
Bass, Berry & Sims
Nashville, Tennessee

Donald J. Schuenke [6,7]
President and Chief Executive Officer
The Northwestern Mutual Life Insurance Company
Milwaukee, Wisconsin

Robert C. Scrivener [1,5,7]
Former Chairman of the Board and Chief Executive Officer
Northern Telecom Limited

William M. Sobey [4,7]
Chairman of the Board
Sobeys Stores Limited
Stellarton, Nova Scotia

James C. Thackray [2,3,4]
Chairman of the Board and Chief Executive Officer
Bell Canada
Montreal, Quebec

Member of the:
[1] *Audit Committee*
[2] *Executive Committee*
[3] *Management Resources and Compensation Committee*
[4] *Operations Advisory Committee, Canada*
[5] *Operations Advisory Committee, International*
[6] *Operations Advisory Committee, United States*
[7] *Pension Fund Policy Committee*

The Board of Directors, which met 12 times in 1983, is responsible for the management of the corporation's business. Directors serve on one or more of the following Board committees:

— *The Audit Committee,* composed of directors who are neither officers nor employees of the corporation. It reviews the corporation's annual consolidated financial statements, registration statements, and prospectuses prior to Board approval. The committee reviews audit activities, and recommends changes in accounting policies for Board approval.

— *The Executive Committee,* which may exercise certain powers of the Board. It approves appropriations, in amounts exceeding the limits of officer authority, for capital investments, for R&D, and for lease expenditures, and approves the disposition of significant capital assets.

— *The Management Resources and Compensation Committee,* which recommends for Board approval the appointment and remuneration of corporate officers, and reviews the appointment and remuneration of the officers of the principal subsidiaries. It also recommends new employee benefit plans and material changes to existing plans. It reviews recruitment and development programs and the plans for succession to senior management. It recommends appropriations under incentive plans. It recommends individuals for nomination to the Board.

— *Operations Advisory Committees*, established in 1983. Three committees serve respectively in a consultative role to Northern Telecom's Canadian, United States, and international principal operating subsidiaries.

— *The Pension Fund Policy Committee,* which approves the investment policies for, and reviews the performance of, the corporation's pension funds. It reviews the actuarial assumptions used to determine the funding requirements for the pension plans.

Senior management of principal subsidiaries

Bell-Northern Research Ltd.

Chairman of the Board
Donald A. Chisholm

President
John A. Roth

Group vice-presidents
Howard M. Bender
Network products

Klaus M. Buechner
Office products

Vice-presidents
John S. Buchan
Transmission products

John Elliott
Corporate development

Thomas M. Hennebury
Human resources and administration

Owen W. McAleer
Networks technology division

George C. Smyth
Digital switching systems development

Anthony G. Stansby
Semiconductor applications

Brian G. Watkinson
Access and services

Secretary and legal counsel
Roméo C. Champagne

Treasurer and controller
David T. Boyce

BNR Inc.

President
Klaus M. Buechner

Vice-president
David A. Twyver
Private switching systems

Northern Telecom Data Systems Limited

Managing director
Barry W. Eames

Northern Telecom AG

Managing director
Hugh A. Hamilton

Northern Telecom (Asia) Limited

Managing director
Hal. A. Rosser

Northern Telecom (CALA) Corporation

President
Ewen B. Morrison

Northern Telecom Canada Limited

President
David G. Vice

Executive vice-presidents
L. Ross Campbell
Administration

H. Lloyd Webster
Marketing and technology

Group vice-presidents
André J. Boutin
Cable

Ewart O. Bridges
Switching

Gedas A. Sakus
Subscriber equipment

Robert R. Watt
Transmission

Vice-presidents
David D. Archibald
Secretary and general counsel

Robert M. Cuddy
Manufacturing

Richard A. Fortier
Human resources

Robert Kenedi
Product line planning

Roy McClean
Operations, Integrated Office Systems

John P. Strimas
Public relations

David J. Thomas
Finance

Elliott Turcot
Advanced switching

Denis Mercier
Cable operations

S. Russ Woodland
Operations, transmission group

Northern Telecom Electronics Limited

President
Charles G. Millar

Vice-presidents
Ronald A. Hunter
Electronic components

A. Graham Sadler
Semiconductor components

Anthony G. Stansby
Business development

Northern Telecom Inc.

President
Desmond F. Hudson

Executive vice-presidents
L. Colin Beaumont
Technology

John W. Caffry
Finance and administration

Thomas R. Worthy
Marketing

Group vice-presidents
Bob G. Davis
Operations, Integrated Office Systems

Edward J. Mattiuz
Integrated Office Systems

Andrew M. McMahon
Integrated Carrier Systems

Roy Merrills
Integrated Network Systems

Vice-presidents
William C. Cawthon
Operations

Jean-Paul Gagnon
Marketing, Integrated Office Systems

Jerry L. Kreiger
Human resources

Wayne R. Lasson
Digital switching systems

Eugene B. Lotochinski
Market development

John MacDonald
President, Northern Telecom Finance Corporation

Edward B. Matthews
Strategic development

Donald K. Peterson
Finance

Richard R. Standel, Jr.
General counsel and secretary

D. Wynn Walters
Public relations

Northern Telecom Industries Sdn. Bhd.

Managing director
Ho Boon Theam

Northern Telecom International Inc.

President
George W. Sullivan

Northern Telecom International Limited

President
Robert A. Ferchat

Vice-presidents
James W. Brown
Finance and administration

Charles M. H. Shiu
Business development

Northern Telecom (Ireland) Limited

Chairman of the Board
Lord Killanin

Managing director
Anthony B. Gorman

Northern Telecom (Middle East) Limited

Managing director
Brian Baynes

Northern Telecom plc

Managing director
Walter C. Benger

Northern Telecom Limited and principal subsidiaries

Northern Telecom Limited sets the policies and long-term growth strategies for the corporation and its subsidiaries. It also carries out administrative and coordinative functions for the global organization. Research and development, manufacturing, marketing, sales, and service are carried out through the corporation's principal operating subsidiaries:

Northern Telecom Canada Limited, with headquarters near Toronto, Ontario, operates 27 manufacturing plants and 16 associated R&D laboratories. It is responsible for the Canadian telecommunications equipment market.

Northern Telecom Inc., based in Nashville, Tennessee, serves the U.S. telecommunications markets with 14 manufacturing plants and 10 associated laboratories for R&D.

Northern Telecom International Limited, headquartered in Mississauga, Ontario, and its subsidiary Northern Telecom International Inc., with head offices in Nashville, market and service the corporation's products outside of North America.

Northern Telecom Electronics Limited, based in Mississauga, manufactures and supplies electronic components for the corporation's other manufacturing operations.

Bell-Northern Research Ltd., Ottawa, Ontario, is owned 70 percent by Northern Telecom and 30 percent by Bell Canada. It operates three laboratories in Ottawa, and one each in Toronto; Montreal, Que.; and Edmonton, Alta. Its U.S. subsidiary, BNR Inc., has laboratories in Mountain View, California; Ann Arbor, Michigan; Richardson, Texas; and Research Triangle Park, North Carolina.

Manufacturing operations

Business communications systems
Canada
Amherst, N.S.
Belleville, Ont.
Calgary, Alta.
Saint John, N.B.
United States
Santa Clara, Cal.
Republic of Ireland
Galway

Cable
Canada
Amherst, N.S.
Calgary, Alta.
Kingston, Ont.
Lachine, Que.
Regina, Sask.

Components
Canada
Belleville, Ont.
Ottawa, Ont.
United States
San Diego, Cal.
West Palm Beach, Fla.
Malaysia
Kedah
Penang

Data Networks
Canada
Belleville, Ont.
Republic of Ireland
Galway

Information processing systems
Canada
Scarborough, Ont.
St. Laurent, Que.
United Kingdom
Hemel Hempstead
United States
Minnetonka, Minn.

Outside plant
Canada
St. Laurent, Que.
United States
Morton Grove, Ill.
Brazil
Rio de Janeiro

Repair and overhaul
Canada
Calgary, Alta.
Montreal North, Que.
North York, Ont.
Saint John, N.B.

Subscriber apparatus
Canada
Amherst, N.S.
London, Ont.
United States
Nashville, Tenn.
Republic of Ireland
Galway

Switching
Canada
Brampton, Ont.
Calgary, Alta.
Charlottetown, P.E.I.
Montreal, Que.
St. John's, Nfld.

United States
Creedmoor, N.C.
Morrisville, N.C.
Raleigh, N.C.
Richardson, Tex.

Test equipment
United States
Concord, N.H.
Moorestown, N.J.

Transmission
Canada
Aylmer, Que.
Saskatoon, Sask.
St. Laurent, Que.
Winnipeg, Man.
United States
Atlanta, Ga.

Computing technologies for the OPEN World

For nearly a century, telephone networks around the world were based on *analog* communications technology. The human voice, and all other information, had to be converted for transmission to an electrical wave, of varying amplitude and frequency, resembling sound.

Today, the world's telecommunications networks are steadily being converted to the technology of the computer—*digital.* All information, including the human voice, is coded in the binary language of computers, providing faster, higher-capacity, and more accurate communications. Today's digital networks can as easily handle the communications of data, graphics, and image information, as they can transmit your voice. Telecommunications systems not only communicate information in the language of computers, they are controlled by computers.

In homes, offices, factories, and other places, yesterday's telephones are being, or likely will be, replaced by integrated information terminals.

For the past two decades, Northern Telecom has been designing computers and applying them to produce more flexible, reliable, capable, and cost-effective telecommunications systems. The corporation's computing expertise enabled it to develop and introduce, in the early 1970s, computer-controlled analog switching systems that were among the most advanced in the industry.

In 1976, Northern Telecom pioneered the global revolution to digital telecommunications with its announcement of the Digital World. The corporation developed and introduced a complete family of fully digital switching and transmission systems, including the DMS and SL Families. It has made Northern Telecom the leading supplier of such systems in the world. By yearend 1983, Northern Telecom had sold, or on order, DMS and SL systems to serve the equivalent of 16.2 million telephone lines in 60 countries.

Under its OPEN World program, announced in November 1982, Northern Telecom is now applying its expertise in computing technologies to improve the management of information. OPEN (Open Protocol Enhanced Networks) World will include the evolution of the DMS and SL systems, and the introduction of new features, services, and information terminals for organizations of all sizes.

Applying computers to communications

The first large-scale, general-purpose electronic digital computer, called ENIAC (Electronic Numerical Integrator and Computer) was completed at the University of Pennsylvania in 1946. It weighed 30 tons and covered 1,500 square feet of floor space. It contained 18,000 vacuum tubes, half-a-million soldered joints, 700,000 resistors, 10,000 capacitors, and 6,000 switches. It needed an enormous amount of power and was subject to failure and errors if tubes or other parts blew.

Electronic computing technology progressed rapidly from that time, spurred by such inventions as, in 1948, the transistor, which rendered vacuum tubes obsolete, and, in 1959, the first microelectronic integrated-circuit devices. By the early 1960s, up to 10 transistors could be implanted on a chip of silicon.

The stage was set for the effective application of electronic computing technology to telecommunications systems.

The first communications switches controlled by electronic computers appeared in the late 1950s. However, these systems were still generally bulky, early generation designs of varying reliability.

In 1965, American Telephone and Telegraph Company's (AT&T) Bell Laboratories introduced the No. 1 ESS, a computer-controlled electronic switching system. Northern Telecom gained its first experience with electronic computer-controlled switches, adapting this system for the Canadian market.

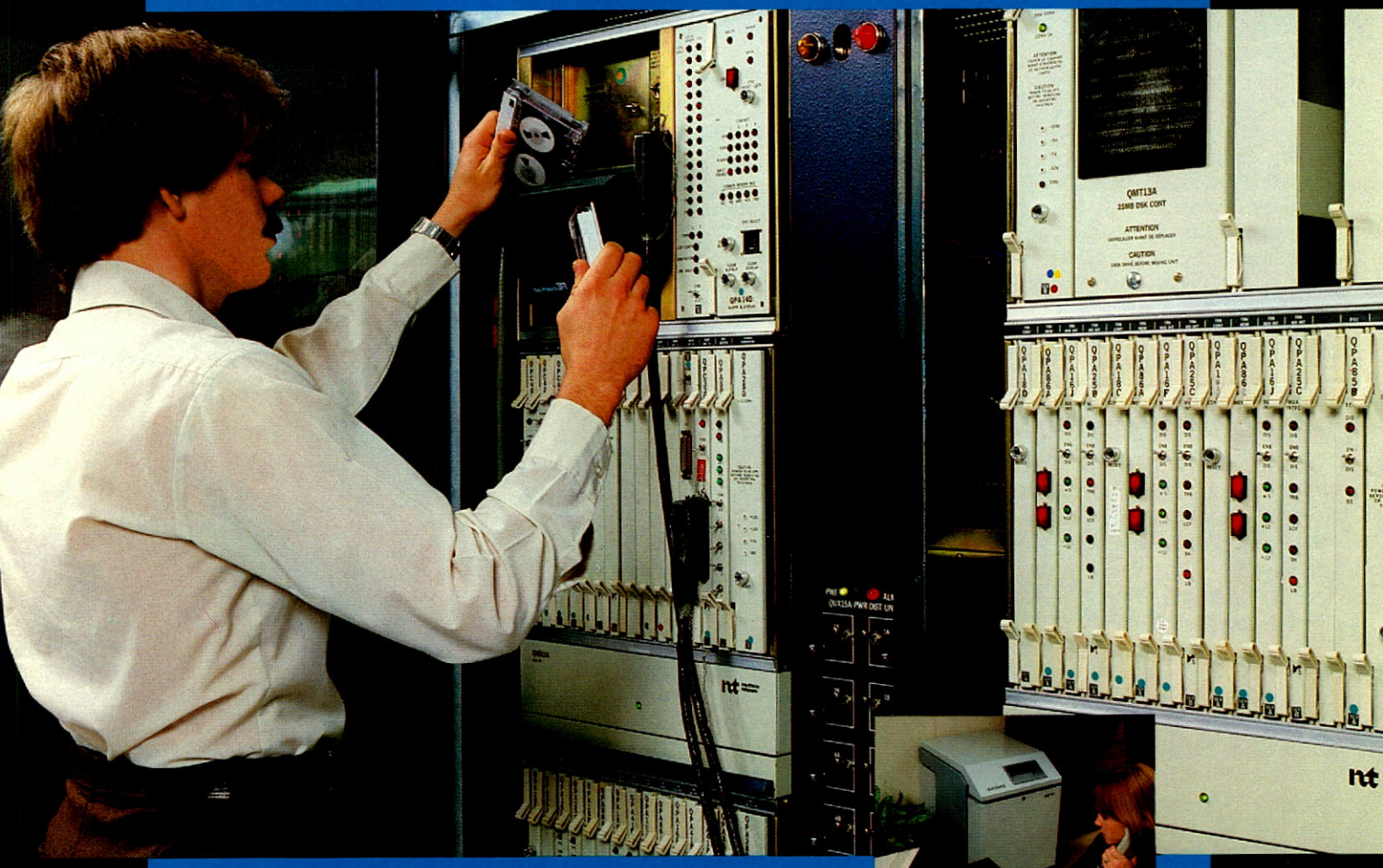
The No. 1 ESS was designed to serve large urban areas. Even before the No. 1 ESS emerged from the laboratories, Northern Telecom and Bell Canada determined that the switch was uneconomical for smaller metropolitan and rural applications.

BNR designs a computer

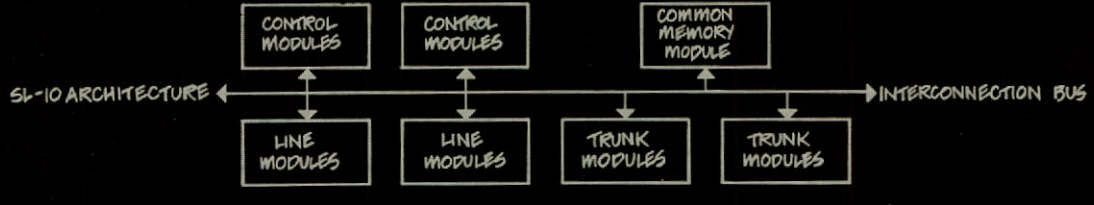
In June 1963, Northern Telecom and Bell Canada made a major decision. They committed their six-year old research and development laboratories to the development of a computer-controlled switching system.

Initially, the project was to develop a medium-sized switch for handling local calls. However, the program was broadened to include development of an entire family of small- and medium-sized local and long-distance switching systems, the SP-1.

Jim Tierney, engineering technologist, SL-10 support, changes the packet switching system's tape cartridge to add new features. In 1984, Northern Telecom will introduce the SL-10 RAPID (Remote Access Programmable Interface Device), a remote protocol converter and concentrator. RAPID (below) is integrated with the SL-10, economically extending the SL-10's capabilities to users remote from central switches.



SL-10 data networks have been sold to customers in 10 countries



The experience gained in designing an entire family of switches based on the development of a modular architecture proved very valuable in future years during the creation of Northern Telecom's digital SL PBXs (private branch exchanges) and DMS (Digital Multiplex System) central office switches.

During the concept stage of the SP-1's development, the designers realized that the highly reliable computers needed to serve as the switch's central control were not commercially available. These included computers which had dual-matched processors so that if one failed, the other would take over to provide uninterrupted telephone service.

Further, telecommunications computers must operate in "real time." Most computers then, and many today, receive information, collect it in batches, and, when instructed, process it sequentially at their own pace. Generally, there is no requirement for instantaneous response or constant interaction with the user.

Telecommunications systems, however, must be capable of both receiving and storing information for future processing, such as for billing, and of instantly interacting with the user and network signals. When you pick up a telephone handset, you expect a dial tone and you expect to have your call immediately processed. That is real-time performance. The computer must be capable of receiving, interpreting, and issuing very quickly a large volume of instructions. When the designers were developing the SP-1 there were no computers available that could provide the required level of reliability and real-time interaction.

Accordingly, to develop the SP-1, Northern Telecom's research and development division, which in 1971 became Bell-Northern Research (BNR), had to design its first computer.

In 1983, Northern Telecom's Memory Systems division, in Ann Arbor, Michigan, introduced the Flashback series (left) of high-performance, one-quarter-inch tape drives, and the Mercury series of high-capacity eight-inch Winchester disk drives. Flashback and Mercury will be used in Northern Telecom's computing systems and are being sold to other manufacturers for use in their products.

Writing software for SP-1

Software is the step-by-step instructions that tell a computer how to perform its tasks. Software controls a broad range of functions in a telephone switching system. For the seemingly simple function of providing dial tone when a telephone handset is lifted, a switching system may execute hundreds of instructions. The software also controls translation of dialed digits to select the appropriate route for a call and to establish the connection.

The role of some software is to control diagnostic and maintenance tasks, and to check the hardware and the performance of other software for faults and correct or report them. Software controls administrative functions such as the change of telephone number assignments. Operating software will control the orderly performance of all the other programs in the switching system.

Software instructs the system to collect and store data, such as billing records. Software provides the flexibility to provide, add, and change a constantly expanding menu of features and services demanded by customers. And, some software is used to control the flow of information between other software and hardware elements so that each part knows what is going on.

In designing the SP-1, it was necessary to write the system's software programs. In early stored-program-controlled switches, such as SP-1, processing power and memory costs were very high. To increase efficiency and save memory space, the software programming language used was a so-called "low-level" assembler or machine language.

Assembler languages permit a programmer to write the machine instructions in symbolic format, translating the logical operations of the system into an appropriate sequence of steps. Assembler languages may be efficient and require little memory space, but they have their drawbacks. They are highly detailed, requiring a massive effort to maintain and manage the effects of even minor modifications. They are difficult to check for accuracy.

The SP-1 project represented hundreds of work-years of effort in design, test, manufacture, and preparation of supporting documentation. At times, the development team exceeded 600 people drawn from BNR, Northern Telecom, and Bell Canada. The organizations acquired a great deal of valuable knowledge about the management and coordination of the design of a large hardware and software system by teams of people at different sites.

SP-1 was introduced in 1971 and within the next few years, it became the largest selling such switching system in North America, outside of the AT&T system. Today, 208 SP-1s are still in operation serving the equivalent of some three million telephone lines. During its initial development and in subsequent years, Northern Telecom invested $104 million in R&D funds in the system. Through 1983, cumulative sales of SP-1 were $1.08 billion.

In March 1984, Northern Telecom will begin shipments of the SL-1N and SL-1XN fully digital PBXs. SL-1N and SL-1XN will be as small as one third the size of the models they succeed, while offering substantially greater integrated voice and data communications capacity. Customers with previously installed SL-1s can upgrade their systems to offer the same capabilities. Stan Nuttal, product manager, business communications systems, Northern Telecom Inc., discusses SL-1N's capabilities with a potential customer, at the TeleCommunications Association show in September 1983, where Northern Telecom announced the new systems.

A new type of PBX

In 1969, BNR began to apply its telecommunications knowledge and growing computer expertise to the development of a new type of PBX.

Introduced in 1972, this system, called Pulse, was the world's first commercially successful, fully electronic, time-division PBX. Time division means that multiple signals can be shared on the same transmission line with each being connected in sequence for a very short period of time.

Pulse employed integrated circuits for a specially developed small computer that controlled the processing of calls. In Pulse, semiconductors replaced electromechanical switches. It was a forerunner of today's digital switches. In a decade, Northern Telecom sold more than 18,000 Pulse PBXs in 20 countries with cumulative revenues in excess of $200 million.

In the early 1970s, microprocessors made their first widespread commercial appearance in pocket electronic calculators.

Microprocessors are basically integrated circuits that are capable of performing the control, arithmetic logic, and processing functions of a computer. Using large-scale integration techniques, designers are able to concentrate tens of thousands of discrete logic elements on a fingernail-sized chip of silicon.

During the past decade, circuit designs and large-scale integration technology have advanced to where today's microprocessors have computing capability on a single chip equal to small mainframe computers of a few years ago. The addition of memory and interface circuits for input and output of information can enable a microprocessor to function as a micro- or mini-computer.

BNR applies microprocessors

BNR's first experience in applying microprocessors occurred as early as 1973 when it undertook to design a new system for telephone operators. The design objective was to create a compact, easy-to-use system that would improve the efficiency of operators and provide them with a business-like, aesthetically pleasing, working environment.

In 1975, this Traffic Operator Position System (TOPS) became an integral member of the SP-1 family. It is believed that TOPS was the first traffic operator console design in the telecommunications industry to employ microprocessors and cathode ray tube (CRT) screens. In 1981, Northern Telecom introduced a redesigned evolution of TOPS to serve operators working with the corporation's DMS-200 long-distance switches. Since 1975, Northern Telecom has sold more than 3,000 TOPS.

The first electronic, computer-controlled telephone switches, such as the SP-1, were designed with all their control intelligence resident in a central processing unit. The development of microprocessors, however, meant that designers could practically, and economically, distribute intelligence throughout the system, placing it closest to where it is needed. Many operations could be handled by these dispersed processors, removing some of the central computer's workload. This improved operating efficiency and enabled the central computer to handle more complex tasks.

Designing Digital World

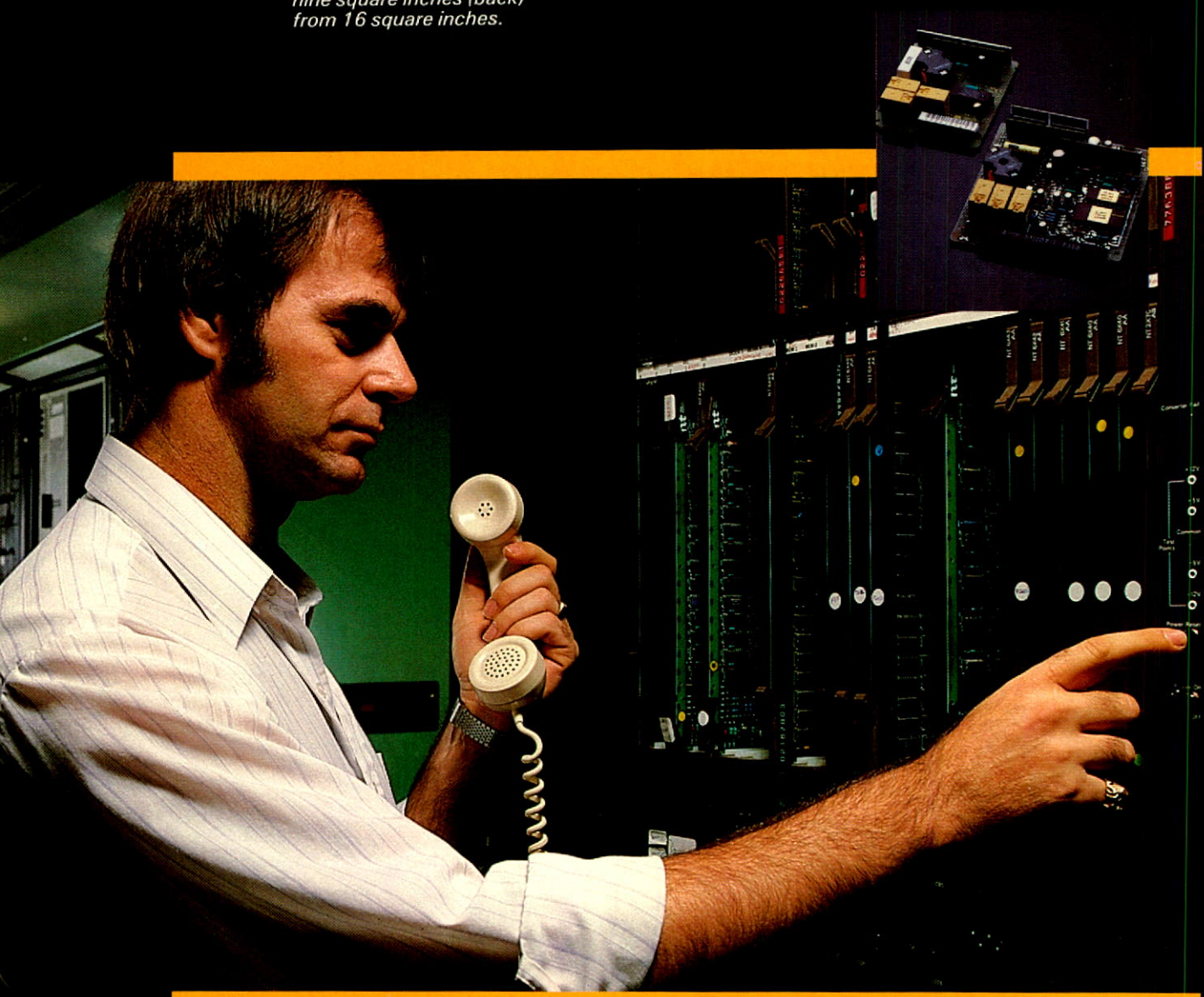
SP-1 and Pulse were controlled by computers, but the information switched was essentially in analog format.

In June 1973, Northern Telecom approved a full-scale development program for its first *fully* digital switching telecommunications system.

The SL-1 digital PBX was the system under development. It represented a formidable design challenge as reported in the Fall 1975 issue of *Telesis,* BNR's technical journal:

''The architecture for SL-1 was to be flexible enough to adapt to evolutionary developments as they came along...

Technician Ray Trudel turns on the power for a new peripheral unit, called a digital trunk carrier, developed for DMS switches. Employing custom LSIs, Northern Telecom has reduced the size of DMS telephone line cards to nine square inches (back) from 16 square inches.



Northern Telecom is the world's leading supplier of fully digital telecommunications systems

"The kind of SPC (stored-program control) called for in SL-1 demands a unique CPU (central processing unit)—one similar to a minicomputer, but one having features far different from those of any commercially available minicomputer. For example, the CPU has to be capable of handling several thousand lines in large SL-1 systems, but must be inexpensive, so that it is not a cost burden at low-line sizes. It has to have the capability for duplication to offer the reliability necessary as the system grows beyond small sizes. Also, it must be able to maintain high-quality service in the event of possible disturbances to the system, such as discontinuity in the source of power. Add to these a need for easy testing, convenient maintenance, and packaging consistent with the rest of the system, and you can see the design challenge."

The application of digital technology for a telecommunications switching system, and the design of a new computer capable of real-time performance to control it, were only two of many innovations for the SL-1.

For example, BNR designed a new kind of electronic key telephone which, for the first time in the world was an integrated part of a PBX system, to provide congenial, single-button access and control of a wide variety of features such as call forwarding and speed dialing. Others later followed Northern Telecom's lead in doing this. The SL-1 set was also the first key telephone to operate over standard twisted-pair telephone wires, compared with the multiple-pair cables used for previous sets. In 1978, Northern Telecom produced prototype fully digital SL-1 sets requested by the U.S. Army.

SL-1's modular hardware and software design permitted single-stream product development of a family of small and large switches. And this modular architecture made it possible to evolve the system's hardware and software into the 1980s to take full advantage of the rapid progress of technology. Indicative of this evolution is the fact that Northern Telecom invested $11 million in the initial development of the SL-1. Through 1983, the corporation had invested an additional $113 million in the system's evolution.

Among the many other innovations was the development of several custom large-scale-integrated (LSI) circuits for such functions as the coding and decoding of analog signals to digital and vice-versa which were key to making the system cost-effective. This use of custom-designed codec (COder/ DECoder) LSIs for each line made the SL-1 a fully digital system. It was the first commercial application of such codecs in the world.

By the early 1970s, the declining cost of computer processing power and memory meant that advances could also be made in software languages from the complex and cumbersome low-level assembler machine languages previously used.

The first "high-level" languages created included Fortran, Cobol, Algol, and PL-1. These enabled programmers to write software instructions in more easily comprehensible code rather than in the difficult assembler dialect. Other software, called a compiler, would then translate the high-level language into machine code for the system to comprehend.

BNR, however, did not find that any of the languages then available measured up to its requirements for the SL-1. High-quality software is a vital determinant of the reliability of the system. It must also be able to provide easy-to-use interfaces between the machine and its users, and be able to handle simultaneously a large number of transactions.

BNR needed a more efficient high-level language for SL-1, which would increase the speed of the system's processors to meet its real-time computing-capacity requirements. Accordingly, BNR created a new high-level language, similar to Algol, called "SL". All programming was done in the new high-level language, making the SL-1 the first system of its kind in the world to do away with assembly language.

Thirteen months after the project go-ahead had been given, in July 1974, the technology trial of the first SL-1 began. In December 1975, Northern Telecom put the first commercial SL-1 in service. Since then, the SL-1 has become the largest-selling fully digital PBX in the world with more than 8,300 systems serving 2.8 million telephone lines in 42 countries. Cumulative SL-1 revenues were about $1.9 billion by yearend 1983.

The SL-1 was the first of Northern Telecom's Digital World of switching systems, proving the corporation's design concepts for application in the development of subsequent systems.

The SL-1 which can handle 30-to-5,000 lines, and the SL-100, introduced in 1981, with a capacity of 30,000 lines, are evolving to serve as the office controllers in Northern Telecom's OPEN World program. In 1983, for example, the corporation announced enhancements and new features for the SL-1 which significantly increase its data-handling capability.

Based on the SL-1 design, BNR developed two other significant systems, the SL-10 data packet switch and the DMS-10, a small central office switch with a capacity to handle 8,000 local lines.

Distributed processing and packet switches

The SL-10 was one of the first data packet switches put in service in the world.

Packet switching is a cost-effective method of transmitting data between computers. Expensive transmission facilities can be used efficiently by interleaving packets of data from many users on the network.

When data is transmitted, there are generally pauses or spaces between the bits of information sent. In most cases, transmitting data over a dedicated line therefore is not cost-efficient because the gaps that are unused between the transmission of data, are still charged to the user.

By contrast, the SL-10 receives data from a user's terminal or host computer, bundles it into packets and interleaves these on the transmission lines with packets of data from other users. The user pays only for the sending of packets rather than for the entire time that the line is in use.

In addition, the SL-10 performs other functions for computer communications. Packet switching provides high availability of the network to users, very-low data error rates, alternate routing in case of transmission line failure, and protocol conversion capability.

Protocols are the rules and regulations computers and telecommunications systems follow to communicate. When computers or terminals use different protocols, they cannot understand one another. The SL-10 converts the sending terminal's protocol to a common protocol for transmission through the network, and converts the message at the last SL-10 node to the receiving system's protocol.

Although similar to the SL-1 in design and using some of its hardware and the high-level SL programming language, the SL-10 represented another step forward in BNR's computing design capability. Whereas previously designed switches were controlled by a central processor, the SL-10 employs multiple processors, distributed throughout the system and tightly linked by software controls.

The first SL-10 was put in service in June 1977 by the TransCanada Telephone System (now called Telecom Canada) to serve as a control for Datapac, Canada's public packet switching network. From four switches installed that year, with 400 connections (each connection representing access for an undeterminable number of computers and terminals), the network has grown to 46 SL-10 switches serving some 14,000 connections.

SL-10-based public and private networks are in service in the United States, where, for example, the Federal Reserve System's SL-10 network handles an estimated US$100 trillion worth of transactions annually. Other networks include: West Germany, where SL-10s are used in the Deutsche Bundespost's public Datex-P network; Belgium; the United Kingdom; Portugal; Hong Kong; Austria; the Republic of Ireland; and Switzerland.

DMS-10: the first fully digital central office

The DMS-10 switching design initially was based on the SL-1's computing technology. However, since their introduction, each has followed its own evolutionary development path in response to the different needs of its users and the progress of technology. DMS-10 was introduced in 1977 as the first of Northern Telecom's new DMS central office switches and as the first such fully digital switch in the world.

The DMS-10's architecture provided for the constant evolution of technology, as reported in the August 1978 issue of *Telesis:*

"The development of new features, which either offer new subscriber services (and thus new revenue opportunities to the operating company) or permit reductions in capital or operating expense, is only one aspect of the ongoing DMS-10 program.

"Of equal importance is the continuing evaluation of new technology opportunities. The current rate of evolution in the digital electronics field is such that several generations of technology will come and go during the life of a digital central office, each offering new possibilities for improved performance and lower costs.

"This is a radical departure from the situation in the electromechanical switching era, when the same technology applied throughout the operational life of a typical office. In this new environment, the products which will survive in the long term will be those which can most effectively apply the evolving technologies not only to new offices, but also to the upgrade of existing installations.

"There are two keys to success in this endeavor, both of which are emphasized in the DMS-10 program. The first is the modularity of the system design. True modularity goes much deeper than the simple use of plug-in circuit cards and connectorized shelves and bays. It involves meticulous attention to the partitioning of the system functions between and within the hardware and software elements of the system, such that software functions are independent of each other and other hardware technology within which they operate.

"Hardware functions must be similarly partitioned, with technology-independent interfaces. Only through such attention to detail in the basic system design is it possible selectively to upgrade parts of the total system without destroying the system integrity.

"The second key is the anticipation of future technology trends to permit optimization of the system configuration to accommodate them."

The subsequent development program of DMS-10 has seen virtually every key part of the hardware replaced by more advanced elements and the software has been continuously enriched. DMS-10 has become the largest selling central office digital switch in North America with more than 1,000 in service or on order by the end of 1983.

The DMS-100 Family design challenge

The design of Northern Telecom's large digital switches, the DMS-100 Family, posed a challenge of new dimensions. This was to create a sufficiently flexible hardware and software architecture that could produce from a single development stream, systems to meet diverse market and customer needs.

The program evolved to include:

- a large local switch, the DMS-100, with a capacity of 100,000 lines;
- a large long-distance switch, the DMS-200, that could serve up to 60,000 circuits;
- a combined local and long-distance switch, the DMS-100/200;
- a gateway switch for handling overseas traffic, the DMS-300;
- a tandem system for the special requirements of the other common carriers in the United States, such as Satellite Business Systems and MCI Communications, the DMS-250;
- the SL-100 PBX;
- a cellular mobile-radio telephone switch, the DMS MTX; and
- special configurations to meet the rigorous requirements of the U.S. Air Force's Scope Dial network, and the U.S. military's automated voice network known as Autovon.

The result was a combination of centralized control and highly dispersed processors for call processing. The switches employ BNR-developed computers and commercially available microprocessors. As an example of the sophisticated computing capability of the DMS-100, each line module in the system, which serves as an interface with up to 640 telephone lines, comprises three microcomputers responsible for various aspects of its performance.

The DMS-100 Family also required a new specially designed software language. Beginning work in 1974, BNR created by 1976 a new language, PROTEL (Procedure Oriented Type Enforcing Language), that is now used in all the DMS-100 Family switches. Among other advantages, PROTEL eliminated the need for any assembly language in these switches.

Like a more recently developed language used by the U.S. Defense Department, called ADA, PROTEL defines programs in terms of sub-routines, or procedures, which are grouped into logical modules, or packages, that form the building blocks to create the system's programs. This makes it much easier to change and add to the programs and to configure a specific set of software features as required for different customers. PROTEL is also similar to another software language, CHILL, recommended by the CCITT (International Telegraph and Telephone Consultative Committee), an international standards-making organization.

Managing software development

The DMS-100 Family now comprises some 4,000 modules of software. The 4,000 modules contain about three million computer instructions. More significant, however, is the rate at which changes are made to the software to provide new features and services.

Three major software-change releases are made for the DMS-100 Family each year; each release may include as many as 500 additional modules. The volume of change now taking place annually equates to what in earlier switches took place every five-to-ten years. More than 250 programmers at three geographic locations, organized into 30 development teams are involved in this program of constant evolution.

This process is accelerating. In the past, each release, every four months, added about 100 features to the system. Currently, each release adds about 300 new features and by 1986 this is expected to double. The DMS-100 Family now offers more than 1,300 different features, making it the most feature-rich digital switching system in the world.

The years of experience BNR has gained in writing and managing software have made the DMS and SL software of very-high quality, a significant factor in the systems' reliability. Software performance can be monitored and diagnosed from remote locations and new programming can be loaded from a laboratory to a system over the telephone network.

To manage its comprehensive software-writing program, BNR has developed sophisticated tools, including computerized automated design and test systems, and a software library system which can support the parallel development of thousands of modules.

The successful development, marketing, evolution, and enrichment of the DMS and SL product families have enabled Northern Telecom to extend its position as the leading supplier of fully digital telecommunications systems. The corporation believes it is at least two years or more ahead of all other manufacturers in hardware and software development of these sophisticated systems.

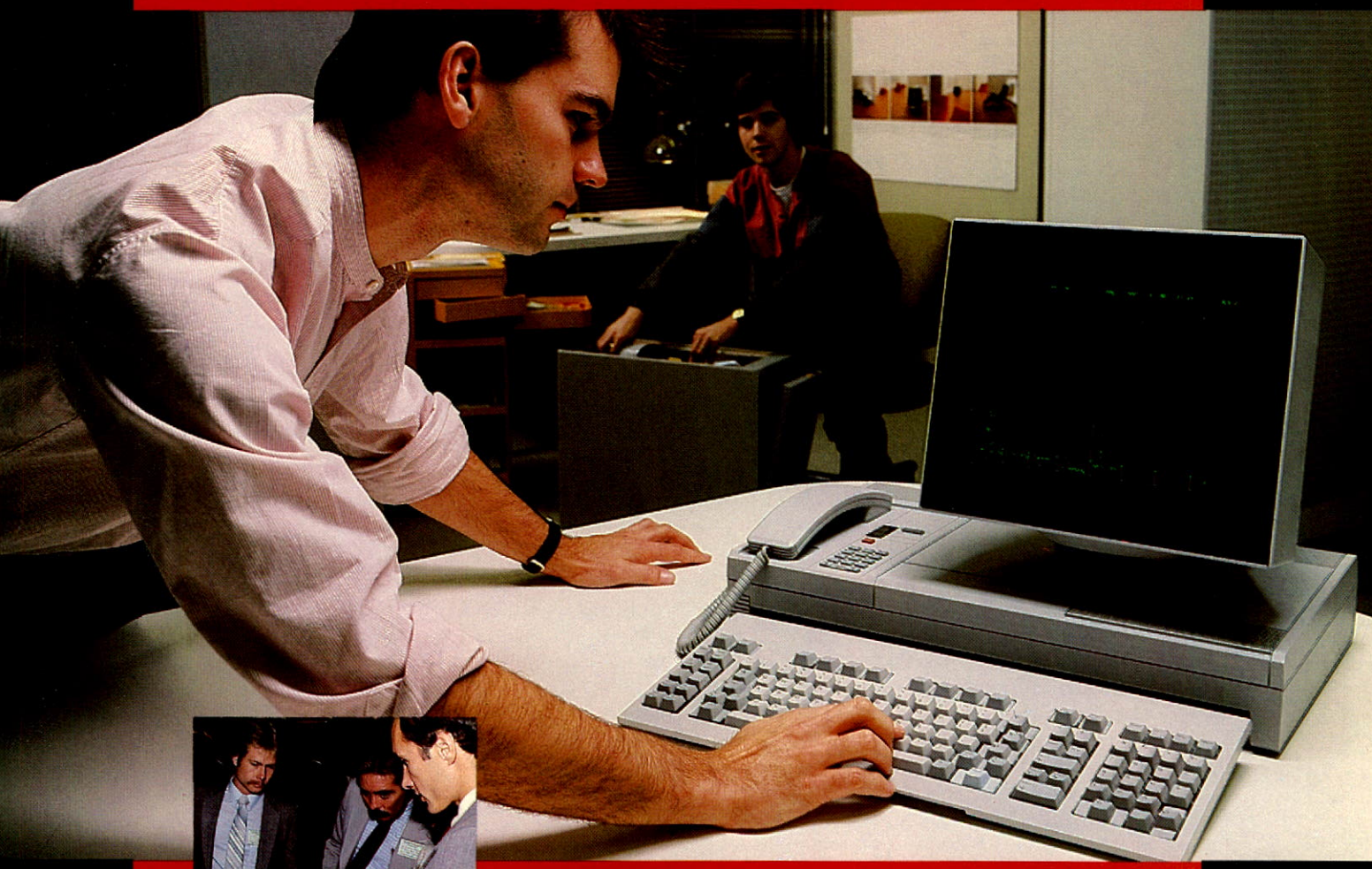
The key role of custom LSIs

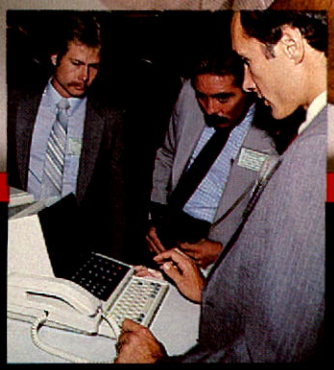
A key factor in Northern Telecom's success is its ability to design and produce custom LSIs. LSIs, or semiconductor chips as they are often commonly called, are used in telecommunications and computer systems to achieve two basic objectives. First, they are the designer's greatest cost-reduction tool. They are media for expressing complex electronics and circuitry in miniature form. They also offer the designer the opportunity to reduce significantly the size of a system and its power consumption. Second, they are used to increase economically the intelligence or functionality of a system.

To achieve these objectives, Northern Telecom designs, develops, and manufactures custom LSIs where it can achieve the greatest advantage in a system's design. In other cases, it uses commercially available semiconductors. The in-house design work is done by BNR and at the design and manufacturing facilities of Northern Telecom Electronics Limited's (NTE) Semiconductor Components Group in Ottawa. NTE has a second production facility in San Diego, California. Northern Telecom's in-house semiconductor manufacturing capability ranks as the fifth largest such operation in North America.

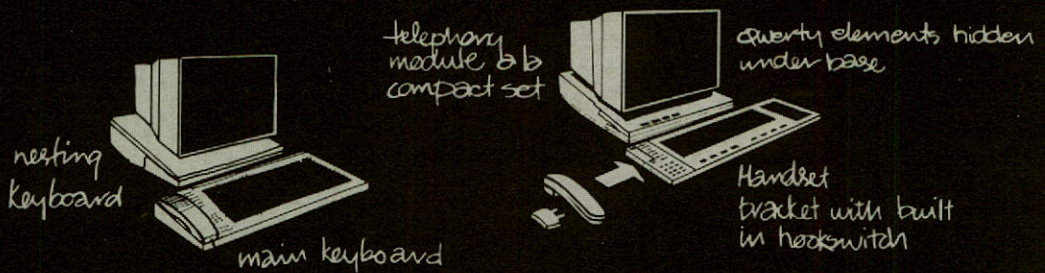
In 1983, NTE supplied nearly eight million semiconductor chips, representing 30 different codes with an estimated value of about $68 million. These semiconductors are used in such systems as the DMS switching and transmission family, the SL Family, and electronic telephones.

At Bell-Northern Research, industrial designers Desmond Ryan (left) and Mike Brown study the features performance of a new integrated voice and data terminal and processor that Northern Telecom will introduce in 1984. In 1982, Northern Telecom began commercial shipments of Displayphone (below), the world's first integrated voice and data terminal.





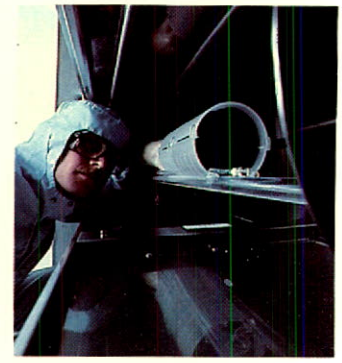
OPEN World includes a family of integrated voice and data terminals


telephony module & compact set
qwerty elements hidden under base
nesting keyboard
main keyboard
Handset bracket with built in hookswitch

By 1985, NTE expects to be supplying about 18 million custom chips of 60 different codes worth about $120 million. This increase might be greater, but an objective is to design LSIs and systems where increasingly a type of chip can be used in multiple systems for further cost savings. As well, higher levels of integration in a single chip means fewer different LSIs are needed.

Northern Telecom's most-advanced LSI is a telephone line-card chip for the DMS-100 Family called the E99. Each E99 chip contains the equivalent of 10,000 transistors, 400 logic cells, and about 8,000 wirings. E99 combines a signal filter, the codec, and some 30 other previously discrete line-card components on a single silicon chip. It is the most advanced chip of its kind available in the world.

An example of the effect of custom LSIs is that in 1984, the use of E99 LSIs and a number of other design improvements will reduce the size of the DMS-100 Family's line card from 16 square inches to nine square inches. Combined with other design changes, this will reduce by half the size of the line-card peripheral frames of these switches.



Technician inspects silicon wafers at Northern Telecom Electronics Limited's semiconductor components manufacturing facility near Ottawa.

The future

In 1980, BNR formed a Computing Technology Group. It is responsible for such areas as programming languages, control software for files and databases, operating systems configurations, and hardware such as processors and memory units. Its responsibility extends throughout BNR and its 10 laboratories in Canada and the United States, and, in future, in the United Kingdom.

The group's development programs include new applications processors, workstations and terminals, and communications networks for the OPEN World.

Computing technology has advanced from the 1960's level to the stage that it is no longer necessary or advantageous for BNR to develop its own processing systems. Today's commercially available 16-bit microprocessors (generally capable of simultaneously processing 16 bits of information at a time) and the 32-bit microprocessors, now becomming available, offer capability on a chip equal to low-end mainframe computers.

To ensure, however, that Northern Telecom does not become solely dependent on the microprocessors of a single supplier, BNR is designing software that is ''portable.'' Using another BNR-developed language–an advanced version of high-level Pascal called BNR Pascal–a BNR-designed compiler can take software developed by BNR or others and adapt it for use on microprocessors or computing systems of other companies.

The Computing Technology Group is one of a number of organizations within BNR and Northern Telecom working on the corporation's five-year, $1.2 billion OPEN World development program.

In 1984, Northern Telecom will introduce a number of new products that will form a highly modular and flexible integrated voice and data office system based on the evolving SL digital PBXs. The new integrated office system will include a star-configuration local area network using ordinary twisted-pair telephone wiring to serve as the high-speed link for the corporation's established Model 500 series of distributed data processing systems and new processors, mass-memory storage systems, integrated voice and data computing workstations, file servers, and printers to be produced by Northern Telecom and other companies.

Organizations–small and large–will be able to plan cost-effective networks combining any or all of these products and those from other manufacturers to provide a broad array of features and services for more efficient management of their information and communications.

The family of integrated voice and data terminals and workstations to be introduced in 1984 and 1985 will be capable of transmitting information over twisted-pair telephone wiring through Northern Telecom's office controllers at speeds well in excess of one million bits of information per second.

With the introduction of an applications processor for the SL-1, Northern Telecom will introduce a number of multi-media enhanced communication services, including conferencing–synchronous communication in voice, data, text, and graphics.

During the past 20 years, with the development, successful introduction, and evolution of such systems as SP-1, TOPS, Pulse, SL-1, SL-10, and the DMS Family, Northern Telecom and Bell-Northern Research have led the world in applying computing technologies to telecommunications. OPEN World is extending this leadership by pioneering the development of new systems and standards for others to follow.

Financial review

Northern Telecom's record financial results in 1983 reflected substantial growth in the United States. This growth more than offset a decline in the corporation's Canadian business caused by reduced capital spending by telephone companies.

Consolidated revenues for 1983 rose 8.8 percent to $3.304 billion, compared with $3.036 billion in 1982, and $2.571 billion in 1981. These increases were attributable primarily to volume growth rather than price increases.

U.S. accounted for majority of revenues

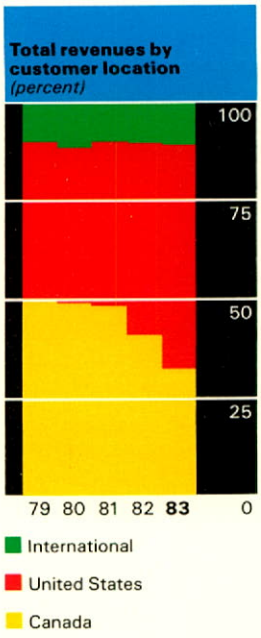
In 1983, for the first time, the United States accounted for more than half of Northern Telecom's revenues. On a geographic basis (the location of the selling organization), U.S. revenues rose 28 percent in 1983 to $1.887 billion (57.1 percent of consolidated revenues). In 1982, U.S. revenues were $1.473 billion (48.5 percent of the total), up from $1.047 billion in 1981 (40.7 percent of revenues).

Canadian revenues declined in 1983 by 10.1 percent to $1.252 billion (37.9 percent of the total). This compared with 1982 revenues of $1.392 billion (45.9 percent of the total) and $1.335 billion in 1981 (51.9 percent of the total).

Outside of North America, revenues in 1983 amounted to $165.2 million (five percent of the total), down 2.7 percent from $169.8 million (5.6 percent of revenues) in 1982, and compared with $189.3 million (7.4 percent of the total) in 1981.

Revenues by destination

The preceding numbers and note 18 to the financial statements report revenues by the location of the organization that invoiced the sale of the product. Measured by destination (the markets where the customers are located), the most significant difference is evident in international markets.



By destination, revenues outside of North America were up 15.7 percent to $376.3 million (11.4 percent of the total) in 1983, compared with $325.2 million (10.7 percent of the total) in 1982, and $271.2 million (10.6 percent of consolidated revenues) in 1981. In 1983, sales increases were attributable particularly to demand for digital switching systems in Trinidad and Tobago, and Bermuda, and for analog switching components for Turkey. European sales of the SL-10 data packet switching system rose. Sales of the SL-1 digital private branch exchange (PBX) to European and Middle Eastern customers declined. Sales to Asian customers declined from the 1982 level when Northern Telecom filled the majority of $80 million of contracts for transmission equipment for South Korea.

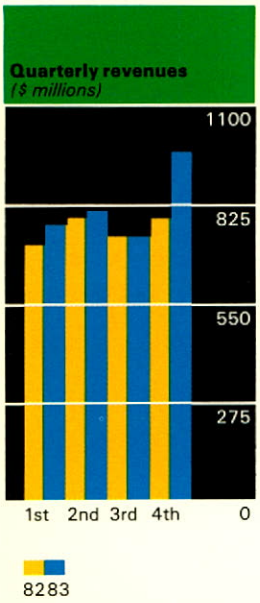
U.S. revenues rose 26.9 percent in 1983 to $1.856 billion, compared with $1.462 billion in 1982 (56.2 percent and 48.2 percent of consolidated revenues, respectively), and $1.052 billion in 1981 (40.9 percent of the total). Growth was achieved in most product lines, led by particularly strong revenue increases for DMS central office switches (up 73.8 percent to $654.7 million); analog and digital tandem switching systems for resale and other common carriers (up 34.1 percent to $138 million); SL-1 and SL-100 PBXs (up 15.5 percent to $471.4 million); and transmission equipment revenues (up 67.9 percent to $218.5 million) in such products as fiber optics systems and digital microwave radio.

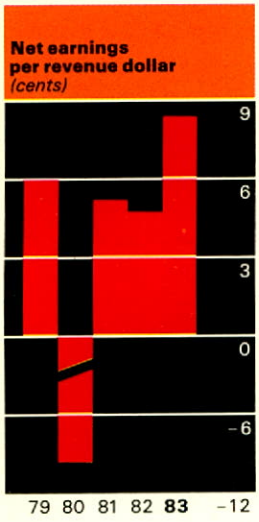
In Canada, revenues declined 14.1 percent to $1.072 billion (32.4 percent of the total), from $1.248 billion in 1982 (41.1 percent of revenues), virtually unchanged from the 1981 level (48.5 percent of consolidated revenues). Canadian revenues declined for all product lines (except business communications systems), following an estimated 19 percent reduction in capital spending by the principal telephone companies in Canada, the corporation's major customers in that market. This reduction followed little increase in 1982 spending compared with the 1981 level. In 1984, the corporation estimates that capital spending by Canadian telephone companies will rise about nine percent, but the amount still will be below even the depressed 1982 level of spending.

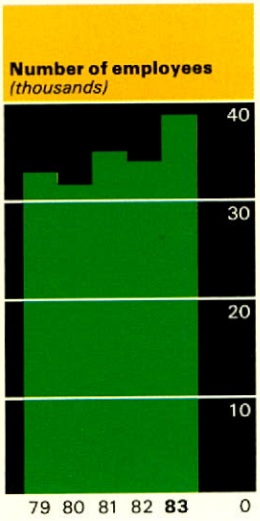
Bell Canada and other subsidiary and associated companies of Bell Canada Enterprises Inc. accounted for $798.9 million, or 24.2 percent, of Northern Telecom's consolidated revenues in 1983, down 12.6 percent from $913.8 million (30.1 percent of the total) in 1982, and $911.7 million (35.5 percent of the total) in 1981. The decline mainly reflects reduced capital spending by those companies.

DMS and SL digital switching led revenues growth

In 1983, Northern Telecom adopted a new framework for reporting revenues. It reflects changes that have been effected in recent years in the corporation's business, products, and markets due, in particular, to the confluence of computer and communication technologies. Under the new framework, the corporation's business comprises six principal product lines within one business segment—telecommunications. The product line revenues in the table on page 30 have been restated to reflect the new reporting structure.







The most significant growth in 1983 was achieved by central office switching. Central office switching includes digital and analog systems. The digital switches include the DMS-10 local system with a capacity of 8,000 telephone lines; the DMS-100 Family that includes the DMS-100 large local switch with a 100,000-lines capacity, the DMS-200 long-distance switch offering up to 60,000 trunks, and the DMS-100/200 combined local and long-distance switch, and the DMS-300 international gateway system; and the DMS-250 tandem switch for resale and other common carriers. Analog switches include the SP-1 stored-program-controlled system and electromechanical crossbar switches.

Revenues from this product line rose 21.4 percent to $1.188 billion in 1983 from $978.7 million in 1982, and $880.1 million in 1981. The growth in 1983 reflected strong demand for DMS switching in the U.S. This growth was offset, in part, by weaker demand for digital switches in Canada caused by the drop in telephone company spending, and by declining sales of analog systems. Globally, sales of DMS (Digital Multiplex System) central office switches (including the DMS-250 tandem switch) were $962.4 million in 1983, up 43.1 percent from $672.5 million in 1982.

The business communications systems product line includes the SL Family of digital PBXs and data packet switches, and key telephone systems such as the Vantage family. Business communications systems revenues rose 15.1 percent to $726.7 million in 1983 compared with $631.1 million in 1982, and $389.1 million in 1981. Globally, revenues for SL PBXs rose 10 percent to $627.2 million in 1983 from $570.3 million in 1982, led by demand for SL-1 systems in the U.S. Revenues for the SL-10 data packet switching system rose 35.3 percent in 1983 to $49.4 million, compared with $36.5 million in 1982.

Transmission equipment includes such product lines as digital subscriber carrier systems (the DMS-1 family), analog and digital microwave radio, digital line carrier, voice frequency equipment, channel banks, private transmission network products, telephone network test systems, and fiber optics systems.

Transmission revenues were $542.3 million in 1983, up 5.6 percent from $513.5 million in 1982, and $381.1 million in 1981. Particularly strong areas included sales of digital radio and fiber optics systems in the U.S. Global fiber optics revenues rose 41.4 percent in 1983 to $56 million from $39.6 million in 1982.

Terminal equipment includes the products that had previously been reported as Electronic Office Systems (EOS), including on-line batch and distributed data processing systems, and the Displayphone integrated voice and data terminal. It also includes telephone sets and related peripherals, refurbishing operations for telephones and other terminals, and data test systems.

Terminal equipment revenues in 1983 were $488.6 million, down 12.5 percent from $558.7 million in 1982, and $548.2 million in 1981. The decline reflects a drop in sales and lease revenues of data systems. Sales of telephone apparatus also declined reflecting, in part, lower sales to the Bell operating companies in the U.S., which, as a step in the restructuring of the American Telephone and Telegraph Company, were not permitted to sell newly purchased equipment during 1983.

Revenues from cable and outside plant products were $283.6 million in 1983, down 2.7 percent from $291.5 million in 1982, and $323.6 million in 1981. The decline was the result of reduced demand for cable in Canada and lower prices during the year, reflecting a drop in copper prices. Revenues for outside plant products were down 1.8 percent in 1983 to $120.1 million from $122.3 million in 1982.

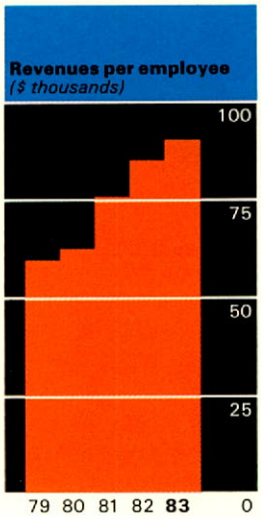
The sixth product line, other telecommunications, mainly comprises R&D done for Bell Canada and other customers, and some sales of integrated circuits. Revenues rose 20.6 percent to $74.8 million in 1983, from $62 million in 1982, and $48.8 million in 1981.

Gross margin increased

The corporation's gross margin rose to 36.1 percent in 1983 resulting in gross profit of $1.192 billion. In 1982, the gross margin was 30 percent with gross profit of $911.3 million; in 1981 the margin was 28.1 percent and gross profit was $723.7 million.

The continuing success of the corporation's cost-reduction and productivity programs contributed to the margin improvement. This was particularly evident in 1983 in Canada where the operating company was able to maintain or even improve its profit margins on some product lines despite lower manufacturing and sales volumes.

During the past three years, Northern Telecom has achieved increasingly higher profitability for DMS switches, making these the corporation's most profitable product line.



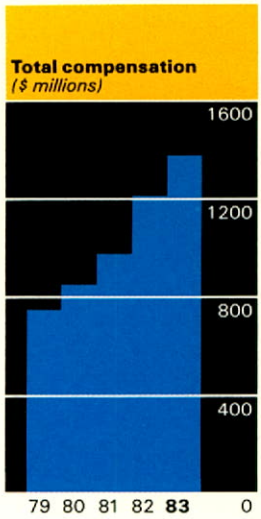
In 1982, the gross profit from the business formerly known as EOS was significantly reduced when a series of costly measures were taken as a part of a restructuring plan to improve future performance of these operations. In late 1982, EOS was combined with other businesses as a part of this plan and is therefore no longer separately reported. However, during 1983 the former EOS product lines showed considerable margin improvement and this was a significant factor in the corporation's improved gross profit performance.

Corporation increased SG&A expenses

Selling, general and administrative expenses (SG&A) amounted to $560.7 million, up 21.4 percent from $461.9 million in 1982, and compared with $359.3 million in 1981. SG&A represented 17 percent of consolidated revenues in 1983, compared with 15.2 percent in 1982, and 14 percent in 1981.

The increase in 1983 is attributable to several factors. Employment by the corporation was increased in sales and marketing to achieve higher revenue growth in 1984 and future years. Higher salary costs and employee-related expenses were also a factor. Northern Telecom has also significantly increased its expenditures in marketing and promotion of the corporation and its products to meet increasingly competitive conditions in all markets.

In 1982, the level of SG&A was affected by costs associated with the restructuring of the EOS operations; higher wages and other employee-related costs; and provisions made under a program to encourage early retirements in Canada in anticipation of the reduced level of manufacturing required to meet lower demand expected in 1983.



Amount and rate of R&D investment increased

In 1983, Northern Telecom increased the amount and rate of its investment in R&D. Net R&D investment was $324.8 million, 9.8 percent of consolidated revenues in 1983, up 34.5 percent from an investment of $241.4 million (eight percent of consolidated revenues) in 1982; the 1981 level was $181.6 million, or 7.1 percent of revenues.

The amount of investment in R&D was in line with the corporation's projections and its stated intent to increase the rate of its spending as a percentage of revenues for the development of new products and the evolution of established systems such as the DMS and SL product families. In 1984, Northern Telecom expects to spend at a rate comparable to the 1983 level and plans to invest about $400 million.

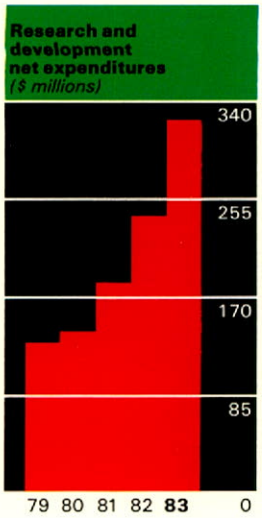
Operating earnings rose 47.4 percent

While higher SG&A expenses and investment for R&D somewhat offset the improved gross profitability, operating earnings for 1983 were $306.5 million, up 47.4 percent from $208 million in 1982, and compared with $182.8 million in 1981. Operating margins were 9.3 percent in 1983, 6.9 percent in 1982, and 7.1 percent in 1981.

Operating earnings on a geographic basis (location of the selling organization) do not include general corporate or R&D expenses. On a geographic basis, operating earnings in Canada increased 8.7 percent to $388.3 million from $357.1 million in 1982, and compared with $324.9 million in 1981.

U.S. operations achieved a 102.4 percent increase in operating earnings to $368.5 million, compared with $182.1 million in 1982, and up from $110.4 million in 1981. U.S. operating profitability improved in 1983 in part because of substantially reduced losses for the products that were formerly included in the EOS business.

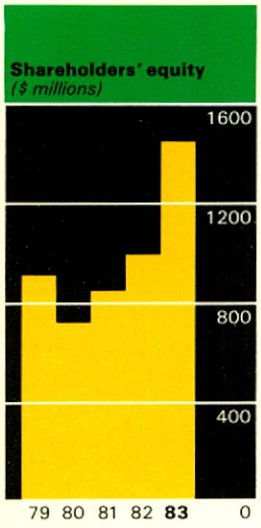
Other (international) operating earnings were $26.9 million in 1983, compared with $36.9 million in 1982, and $30.7 million in 1981.



Net interest charges declined

The corporation's net interest charges declined in 1983 and 1982 as a result of lower average borrowings and declining interest rates. Interest charges net of operating earnings of non-consolidated finance subsidiaries were $10.6 million in 1983, compared with $39.6 million in 1982, and $64.2 million in 1981.

Including the current portion, total long-term debt and Scientific Research Investment Contracts (SRICs), outstanding at yearend 1983, 1982, and 1981, respectively, were $190.8 million, $340.3 million, and $318 million. Short-term debt outstanding at the end of the respective years was $1.6 million, $1.3 million, and $59.4 million. The average rate on long-term and short-term debt at yearend 1983 was 7.9 percent, compared with 8.8 percent at yearend 1982, and 12.8 percent at yearend 1981.



New foreign currency translation policy

In 1983, Northern Telecom adopted The Canadian Institute of Chartered Accountants' new recommendations for accounting for foreign currency translation (see notes 1b and 2 to the financial statements). There are no significant differences affecting the corporation's financial statements for 1983 and 1982 between Canadian and U.S. generally accepted accounting principles.

Income taxes and extraordinary items

The 1983 provision for income taxes was $98 million, or 30.1 percent of pre-tax earnings, compared with $60.4 million, or 31.3 percent of 1982 pre-tax earnings, and $35.8 million, or 24 percent of 1981 pre-tax earnings.

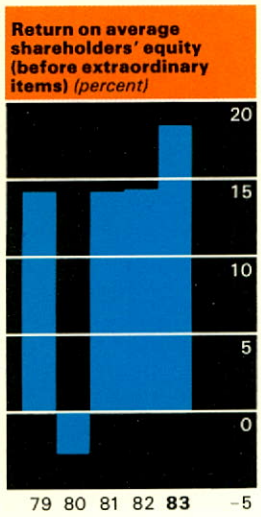
In 1983 and 1982, the corporation fully used all its available accounting tax loss carryforwards. This resulted in extraordinary gains of $41.3 million, or $0.37 per share, in 1983, and $7 million, or $0.06 per share, in 1982.

In the first-quarter 1981, the corporation recorded an extraordinary gain of $16 million, or $0.15 per share, on the sale of an investment in the shares of Intersil, Inc. The extraordinary gain in 1981 would not be reported as an extraordinary item under U.S. generally accepted accounting principles.

Record net earnings

Net earnings, before extraordinary gains, rose 71.5 percent from a record 1982 level to $227.1 million, or $2.05 per share. In 1982, net earnings before extraordinary gains were $132.4 million, or $1.26 per share, compared with $113.2 million, or $1.09 per share, in 1981. Earnings per share reflect a three-for-one split of the corporation's common shares approved by the shareholders at the 1983 annual meeting and effective May 11.

Including the extraordinary gains, net earnings in 1983 were $268.4 million, or $2.42 per share, compared with $139.4 million, or $1.32 per share, in 1982, and $129.2 million, or $1.24 per share, in 1981.



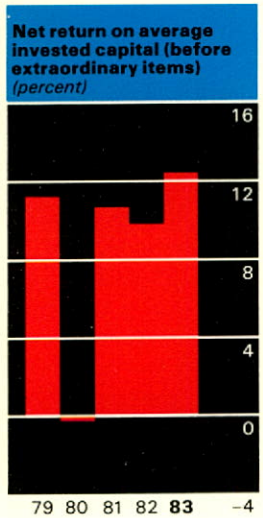
The return on average shareholders' equity, before extraordinary items, in 1983 was 18.4 percent, compared with 14.3 percent in 1982, and 14.2 percent in 1981.

Net return on average invested capital, before extraordinary items, in 1983 increased to 12.3 percent from 9.3 percent in 1982, and 10 percent in 1981. This ratio is calculated by adding after-tax earnings before extraordinary items to interest charges on long-term debt (after tax), and dividing by invested capital; invested capital comprises the long-term portion of long-term debt, amounts due to non-consolidated subsidiaries, SRICs, deferred income, deferred income taxes, minority interest, and shareholders' equity.

Book value of the corporation's common shares rose to $12.79 at yearend 1983, compared with $9.45 and $8.12 at yearend 1982 and 1981, respectively.

Liquidity and capital resources

In 1983, cash provided by operations was $271.9 million, compared with $355.9 million in 1982, and $127.2 million in 1981. The lower level of cash provided by operations in 1983, compared with 1982, was due to the reinvestment of working capital.



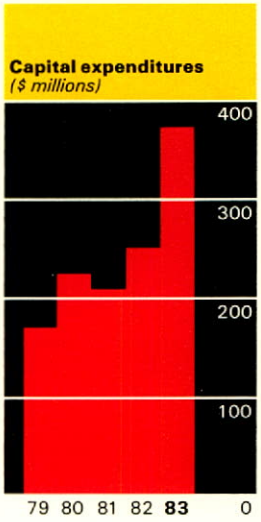
Cash and short-term investments decreased by $41.3 million during 1983 to $108.3 million at yearend due to increased receivables, inventories, and capital expenditures. The corporation received $54 million of dividends from a non-consolidated finance subsidiary.

Working capital increased in 1983 by $65.4 million to $701.5 million, compared with an increase in 1982 of $138 million to $636.1 million, and in 1981 of $41.9 million to $498.1 million. The current ratio was 1.80:1 at yearend 1983; 1.94:1 and 1.75:1 at yearend 1982 and 1981, respectively.

Capital expenditures in 1983, including additions to the leasebase, amounted to $376.9 million, up 49.2 percent from $252.6 million in 1982, and compared with $209.6 million in 1981. In 1984, the corporation expects its capital spending to amount to about $500 million.

The increases in 1983 capital spending were, in particular, to provide for production capacity for such products as digital central office switches, business communications systems, and fiber optics systems, and the introduction of new products and systems. Significant investments were, and will be, made in computerized design, manufacturing, and test systems, in flexible manufacturing devices to increase productivity, and in additional research and development facilities such as the Ottawa, Ontario laboratories built in 1983 for the corporation's R&D subsidiary, Bell-Northern Research Ltd.

Capital requirements in 1984 will be met principally from cash and short-term investments, and internally generated funds. The corporation also expects to continue to take advantage of attractive financing opportunities it may identify.

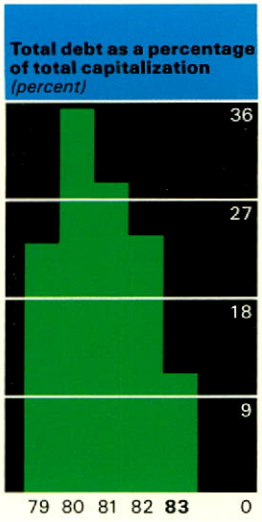


In June 1982, Northern Telecom sold privately US$25 million ($30.7 million) 9¼ percent subordinated seven-year notes with warrants to purchase 1.5 million common shares of the corporation at US$15.42. The exercise premium at the time of issue was 27 percent. On February 17, 1983, against surrender of these notes, the holder exercised the warrants attached and purchased 1.5 million shares at US$15.42 each and received a cash payment of US$1.875 million.

In December 1981, Northern Telecom privately placed US$50 million ($61.4 million) of 12¼ percent subordinated convertible notes due December 1, 1993. On March 7, 1983, as a result of a notice of prepayment from the corporation, the holders of these notes exercised their rights to convert their notes into 2,439,021 common shares at US$20.50 per share.

On March 30, 1983, Northern Telecom prepaid to a U.S. financial institution US$25 million ($30.7 million) of notes due December 1985.

In March 1983, a wholly owned non-consolidated finance subsidiary of the corporation, Northern Telecom International Finance B.V. (NTIF) of the Netherlands, completed a public offering in Europe of US$50 million ($61.8 million) of seven percent convertible subordinated debentures due March 1, 1998. The debentures are unconditionally guaranteed on a subordinated basis by the corporation and are convertible into common shares of Northern Telecom at US$29.6666 per share. At December 31, 1983, US$5,985,000 principal amount of the debentures had been converted, resulting in the issuance of 201,737 common shares. The holders of the remaining outstanding debentures may tender on March 1, 1985 or March 1, 1986 for redemption at 100 percent of the principal amount. NTIF has the right to call for redemption the outstanding debentures if the market price of the corporation's common shares is at least 120 percent of the conversion price for a specified period.

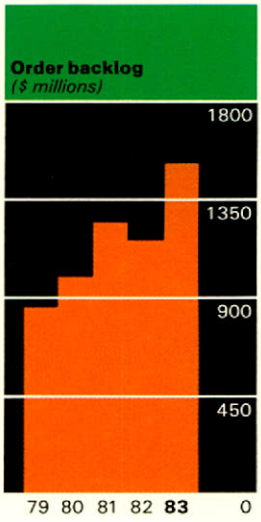


In December 1982, NTIF completed a public offering in Europe of US$80 million ($99.3 million) of seven percent convertible subordinated debentures due December 1, 1997. The debentures were convertible into the corporation's common shares at US$24.3333 per share. NTIF called for redemption on November 23, 1983 all the outstanding 1997 debentures at a price of US$1,073.44 per $1,000 principal amount, which included accrued interest and a four percent premium. Virtually all the debentures were converted, resulting in the issuance of 3,286,649 common shares.

Amounts due to non-consolidated finance subsidiaries decreased in 1983 by $59.4 million to $315.2 million.

Through the corporation's Shareholder Dividend Reinvestment and Stock Purchase Plan, $26.9 million of dividends and additional cash were invested in 1983, $20.4 million in 1982, and $20 million in 1981. These amounts included $23.6 million, $19.4 million, and $19 million, respectively from Bell Canada Enterprises Inc., the corporation's majority shareholder. Investment plans for employees raised $8.8 million in 1983, $7.3 million in 1982, and $3.1 million in 1981 through the issue of the corporation's common shares.

Total debt as a percentage of total capitalization was 11 percent at the end of 1983, compared with 23.8 percent at yearend 1982, and 28.5 percent at the end of 1981 (total capitalization comprises notes payable, SRICs, total long-term debt, deferred income taxes payable, minority interest, and shareholders' equity).



Order input was $3.5 billion; backlog up 30 percent

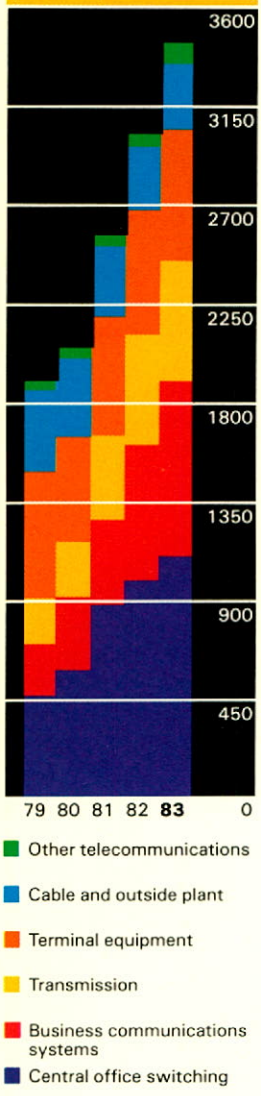
Reflecting mainly growing demand for DMS and SL switching, order input in 1983 was a record $3.48 billion, 26.8 percent higher than the $2.744 billion of orders received in 1982, and compared with $2.67 billion of orders in 1981.

At December 31, 1983, the backlog of orders on hand was the highest for any quarter in the corporation's history at $1.529 billion, up $356 million, or 30.3 percent, from the year earlier level of $1.173 billion; the backlog at yearend 1981 was $1.256 billion. Virtually all the backlog is for delivery in 1984.

Historically, orders for central office switches have accounted for the largest part of the backlog, reflecting the time needed to produce these large systems. This, and the continuing strong demand for these systems, explains why DMS central office switching represented $856.9 million, or 56 percent of the order backlog at yearend 1983. It is the corporation's policy to include in the backlog only firm orders for specific systems. Accordingly, while Northern Telecom signed a number of significant supply agreements with major customers during the past several years, only a portion of an agreement's expected value is included in the order backlog at any given date.

Orders from customers in the U.S. represent a growing amount of the backlog. At yearend 1983, orders on hand from U.S. customers were 42 percent higher than a year earlier, and at $1.079 billion, represented 71 percent of the total backlog. This compared with 65 percent ($758 million) of the order backlog at yearend 1982. Orders on hand from Canadian customers at yearend 1983 were $331.6 million, up 10.2 percent from a year earlier,

Revenues by principal product lines
($ millions)



representing 21.7 and 25.6 percent respectively of the yearend backlogs. International customers accounted for the balance of orders amounting to 7.8 percent of the 1983 yearend backlog ($118.6 million), compared with 9.8 percent ($114.4 million) a year earlier.

Shares hit new highs

Northern Telecom's common shares are listed on the Montreal, Toronto, Vancouver, and New York stock exchanges. The following table shows the high and low sale prices of the shares (adjusted for the three-for-one split) on the Montreal and Toronto exchanges (taken together), and as reported on the composite tape in the United States, which includes trading on the New York Stock Exchange (NYSE). In September 1983, the corporation's shares traded at 60⅝ in Canada and 49⅛ on the NYSE, the highest level since Northern Telecom publicly issued shares in 1973.

	1983				1982			
	Montreal/Toronto (C$)		United States (US$)		Montreal/Toronto (C$)		United States (US$)	
	High	Low	High	Low	High	Low	High	Low
First quarter	33⅝	27¼	27⅝	22⅛	20⅛	16⅜	16¾	13⅜
Second quarter	38⅝	31	41	25	19	14⅞	15⅝	11⅝
Third quarter	60⅝	44	49⅛	35½	18⅛	13⅝	14⅞	10⅞
Fourth quarter	58⅛	46⅞	47¼	37⅜	29⅝	17⅜	24¼	14⅛

At December 31, 1983, Bell Canada Enterprises Inc. owned 51.9 percent of Northern Telecom's shares. The remaining 48.1 percent of the shares were owned by about 13,535 registered shareholders.

Dividends

In 1983, Northern Telecom paid a cash dividend each quarter of $0.10 per share, for a total of $0.40 for the year, and in 1982 paid cash dividends of $0.0833 per share each quarter (after reflecting the stock split). The total amounts paid out as dividends in 1983 and 1982 were $44.7 million and $35.1 million, respectively. The corporation's dividends are declared in Canadian funds; shareholders may choose to receive payment in U.S. funds (based on a conversion rate). Shareholders may invest dividends and optional cash payments under the Shareholder Dividend Reinvestment and Stock Purchase Plan.

Northern Telecom intends to continue paying quarterly dividends. The level of payments will be determined by the Board of Directors based on such considerations as the level of earnings from operations, capital requirements, and the corporation's financial condition.

Under the Income Tax Act (Canada), the withholding tax on dividends paid or credited on Northern Telecom shares is 25 percent (unless reduced by treaty). Under the present United States-Canada Tax Treaty, the rate of withholding tax on Northern Telecom dividends paid or credited to individuals residing in, or corporations organized under the laws of the United States, and not having a ''permanent establishment'' in Canada, is 15 percent.

Under the present United States-Canada Tax Treaty, the gains derived in Canada from the sale or exchange of Northern Telecom shares by an individual resident of the United States or by a corporation or other entity organized under the laws of the United States, are exempt from taxation in Canada provided that the individual or corporation has no ''permanent establishment'' in Canada.

Revenues by principal product lines

	1983	1982	1981	1980	1979
Central office switching	**$1,188.0**	$ 978.7	$ 880.1	$ 575.6	$ 456.9
Business communications systems	**726.7**	631.1	389.1	328.8	240.3
Transmission	**542.3**	513.5	381.1	256.2	203.7
Terminal equipment	**488.6**	558.7	548.2	488.0	586.9
Cable and outside plant	**283.6**	291.5	323.6	361.6	366.7
Other telecommunications	**74.8**	62.0	48.8	44.4	46.0
Total	**$3,304.0**	$3,035.5	$2,570.9	$2,054.6	$1,900.5

Consolidated statement of operations

Northern Telecom Limited and subsidiary companies
Year ended December 31
(millions of dollars except per share figures)

	1983	1982*	1981*
Revenues (note 18)	**$3,304.0**	$3,035.5	$2,570.9
Cost of revenues	**2,112.0**	2,124.2	1,847.2
Gross profit	**1,192.0**	911.3	723.7
Selling, general and administrative expense	**560.7**	461.9	359.3
Research and development expense (note 4)	**324.8**	241.4	181.6
Operating earnings	**306.5**	208.0	182.8
Investment and other income (net)	**24.4**	25.6	31.1
Interest charges – long-term debt (note 11)	**(6.2)**	(26.8)	(41.1)
– other	**(4.4)**	(12.8)	(23.1)
Foreign currency gains (losses)	**4.8**	(1.2)	(.7)
Earnings before income taxes and extraordinary items	**325.1**	192.8	149.0
Provision for income taxes (note 5)	**(98.0)**	(60.4)	(35.8)
Earnings before extraordinary items	**227.1**	132.4	113.2
Extraordinary items (notes 3 and 6)	**41.3**	7.0	16.0
Net earnings (note 3)	**$ 268.4**	$ 139.4	$ 129.2
Earnings per share (note 3)			
– before extraordinary items	**$ 2.05**	$ 1.26	$ 1.09
– after extraordinary items	**$ 2.42**	$ 1.32	$ 1.24
Dividends declared per common share	**$ 0.40**	$ 0.333	$ 0.333
Weighted average number of common shares outstanding (thousands)	**110,926**	105,492	103,886

*Restated – see notes 2 and 13

The important difference between Canadian and United States generally accepted accounting principles affecting the consolidated statement of operations is described and reconciled in note 3.

Consolidated statement of retained earnings

Northern Telecom Limited and subsidiary companies
Year ended December 31
(millions of dollars)

	1983	1982*	1981*
Balance at beginning of year	**$443.7**	$339.4	$244.9
Add: Net earnings	**268.4**	139.4	129.2
	712.1	478.8	374.1
Deduct: Dividends	**44.7**	35.1	34.7
Balance at end of year	**$667.4**	$443.7	$339.4

*Restated – see note 2

Management's report

The accompanying consolidated financial statements of Northern Telecom Limited and its subsidiaries and all information in this annual report are the responsibility of management and have been approved by the Board of Directors.

The financial statements have been prepared by management in conformity with Canadian generally accepted accounting principles. The financial statements include some amounts that are based on best estimates and judgments. Financial information used elsewhere in the annual report is consistent with that in the financial statements.

Management of the corporation and its subsidiaries, in furtherance of the integrity and objectivity of data in the financial statements, has developed, and maintains, a system of internal accounting controls, and supports an extensive program of internal audits. Management believes that this system of internal accounting controls provides reasonable assurance that financial records are reliable and form a proper basis for preparation of financial statements, and that assets are properly accounted for and safeguarded. The internal accounting control process includes management's communication to employees of policies which govern ethical business conduct.

The Board of Directors carries out its responsibility for the financial statements in this annual report principally through its Audit Committee, which consists of directors who are not officers or employees of the corporation or any of its affiliates. The Audit Committee reviews the corporation's annual consolidated financial statements and recommends their approval to the Board of Directors. The shareholders' auditors have full access to the Audit Committee, with and without management being present.

These financial statements have been examined by the shareholders' auditors, Touche Ross & Co., chartered accountants.

Consolidated balance sheet

Northern Telecom Limited and subsidiary companies
As at December 31
(millions of dollars)

	Assets	1983	1982*
Current	Cash and short-term investments at cost (approximates market value)	**$ 108.3**	$ 149.6
	Accounts receivable		
	Affiliated companies	**98.8**	59.2
	Trade (less provision for uncollectibles $31.3 for 1983, $20.4 for 1982)	**650.8**	491.3
	Inventories (note 7)	**672.8**	577.6
	Prepaid expenses	**11.8**	12.3
	Deferred income taxes	**31.2**	24.2
		1,573.7	1,314.2
Long-term receivables		**36.1**	51.5
Investments	Non-consolidated finance subsidiaries (note 8)	**420.6**	422.3
	Associated companies and other	**12.4**	10.8
		433.0	433.1
Other	Plant and equipment – net (note 9)	**803.6**	616.4
	Goodwill and other assets (note 1)	**26.6**	28.2
	Total assets	**$2,873.0**	$2,443.4

	Liabilities		
Current	Notes payable	**$ 1.6**	$ 1.3
	Accounts payable and accrued liabilities		
	Affiliated companies	**7.5**	3.2
	Payroll accrued	**63.6**	51.8
	Trade and other	**678.5**	513.4
	Taxes payable	**59.8**	63.9
	Due to non-consolidated finance subsidiaries (note 8)	**33.4**	8.9
	Scientific research investment contracts due within one year (note 10)	**24.5**	22.1
	Long-term debt due within one year (note 11)	**3.3**	13.5
		872.2	678.1
Long-term	Deferred income	**3.1**	3.8
	Due to non-consolidated finance subsidiaries (note 8)	**281.8**	365.7
	Scientific research investment contracts (note 10)	**35.7**	60.1
	Long-term debt (note 11)	**127.3**	244.6
	Deferred income taxes	**73.9**	73.0
	Minority interest in subsidiary company	**13.5**	12.6
		1,407.5	1,437.9

	Shareholders' equity		
	Stated capital (114,607,222 common shares outstanding in 1983, 106,352,286 in 1982) (note 13)	**755.7**	524.4
	Retained earnings	**667.4**	443.7
	Foreign exchange adjustment (note 14)	**42.4**	37.4
		1,465.5	1,005.5
Commitments and contingencies (note 17)			
	Total liabilities and shareholders' equity	**$2,873.0**	$2,443.4

*Restated – see note 2

On behalf of the Board of Directors

John H. Moore
Director

W. O Beers

William O. Beers
Director

Consolidated statement of changes in financial position

Northern Telecom Limited and subsidiary companies
Year ended December 31
(millions of dollars)

		1983	1982*	1981*
Cash and short-term investments	Provided by (applied to):			
	Operations	**$271.9**	$355.9	$127.2
	Investment	**(357.5)**	(234.3)	(135.0)
	Financing	**89.0**	37.0	55.2
	Dividends	**(44.7)**	(35.1)	(34.7)
	Increase (decrease) in cash and short-term investments	**(41.3)**	123.5	12.7
	Cash and short-term investments at beginning of year	**149.6**	26.1	13.4
	Cash and short-term investments at end of year	**$108.3**	$149.6	$ 26.1
Cash provided by operations	Earnings before extraordinary items	**$227.1**	$132.4	$113.2
	Items not requiring cash			
	Depreciation and amortization	**161.8**	177.1	124.0
	Equity in earnings of non-consolidated finance subsidiaries	**(49.8)**	(57.0)	(59.0)
	Deferred income taxes	**.9**	(1.1)	(13.1)
	Other	**14.3**	7.9	(.9)
	Extraordinary item	**41.3**	7.0	—
	(Increase) decrease in working capital (note 15)	**(123.7)**	89.6	(37.0)
	Total	**$271.9**	$355.9	$127.2
Cash invested	Expenditures for plant and equipment	**$376.9**	$252.6	$209.6
	Disposals of plant and equipment	**(24.8)**	(25.6)	(28.2)
	Extraordinary item	**—**	—	(54.8)
	Other	**5.4**	7.3	8.4
	Total	**$357.5**	$234.3	$135.0
Financing	(Increase) decrease in long-term receivables	**$ 15.4**	$(22.5)	$ 4.1
	Increase (decrease) in			
	Notes payable	**.3**	(58.1)	(73.0)
	Amount due to non-consolidated finance subsidiaries	**(59.4)**	67.7	51.0
	Proceeds from scientific research investment contracts	**—**	70.0	20.0
	Payments under scientific research investment contracts	**(22.0)**	(2.8)	—
	Additions to long-term debt	**11.5**	32.3	83.0
	Reductions of long-term debt	**(78.9)**	(77.3)	(105.8)
	Conversion of long-term debt	**(61.1)**	—	—
	Issue of common shares	**231.3**	27.7	23.1
	Investment in non-consolidated finance subsidiaries	**(.5)**	—	(6.9)
	Dividends from non-consolidated finance subsidiary	**54.0**	—	59.7
	Other	**(1.6)**	—	—
	Total	**$ 89.0**	$ 37.0	$ 55.2

*Restated – see note 2

Notes to consolidated financial statements

Northern Telecom Limited and subsidiary companies
(millions of dollars except per share figures)

1. Accounting policies

The accompanying financial statements have been prepared on the historical cost basis in accordance with Canadian generally accepted accounting principles and conform in all material respects with International Accounting Standards. With respect to the consolidated financial statements of Northern Telecom Limited (NTL) and its subsidiary companies (collectively, the corporation), the important difference between Canadian and United States generally accepted accounting principles is described and reconciled in note 3.

a) Principles of consolidation

The consolidated financial statements include the accounts of NTL and all subsidiary companies, except the finance subsidiary companies which are accounted for by the equity method.

The finance subsidiaries are not consolidated as their business is fundamentally different from that of the consolidated group. In the consolidated statement of operations, the earnings from operations of the finance subsidiaries reduce long-term interest charges and foreign currency gains or losses and income taxes of the finance subsidiaries are included in the respective captions.

b) Translation of foreign currencies

Foreign subsidiaries are classified as either integrated or self-sustaining.

Integrated foreign subsidiaries are those whose economic activities have a direct effect on the cash flows and operations of the parent company. Current assets (excluding inventories and prepaid expenses), current liabilities, and long-term monetary assets and liabilities are translated at the exchange rates in effect at the balance sheet date; other assets and other liabilities are translated at the actual rates in effect when the originating transactions took place. Revenues and expenses are translated at approximately average rates for the year except for cost of revenues, depreciation, and amortization, which are translated at the actual rates in effect when the related assets were manufactured or acquired. Translation gains and losses are reflected in consolidated net earnings.

Self-sustaining foreign subsidiaries are those whose economic activities are largely independent of those of the parent company. Assets and liabilities are translated at the exchange rates in effect at the balance sheet date. Revenues and expenses, including gains and losses on foreign exchange transactions excluding long-term intercompany advances, are translated at approximately average rates for the year. The unrealized translation gains and losses on the parent company's net investment in these subidiaries are accumulated in a separate component of shareholders' equity, described in the consolidated balance sheet as foreign exchange adjustment. These gains or losses may become realized on the payment of dividends by, or such other changes in the capital structure of, a subsidiary, in which event an appropriate portion of foreign exchange adjustment is transferred and reflected in consolidated net earnings.

NTL's U.S. dollar-denominated long-term debt is regarded as a partial hedge of NTL's net investment in its U.S.-based self-sustaining subsidiaries. Accordingly, unrealized exchange gains and losses on this debt are allocated to foreign exchange adjustment.

c) Rental revenue

For operating leases, rental revenue is recognized when billed to customers. For leases which qualify as sales-type leases, the present value of future rental payments is recorded as sales revenue at the inception of the lease.

d) Depreciation

Depreciation is calculated generally on the straight-line method using rates based on the expected useful lives of the respective assets as follows:

Buildings 20-to-40 years; machinery and equipment 3-to-16 years; and equipment for lease to customers three-to-four years.

e) Research and development

Research and development costs are charged to earnings in the periods in which they are incurred, except for costs incurred pursuant to specific contracts with third parties for the manufacture of telecommunications equipment, which are charged to earnings in the same period as the related revenue is recognized.

f) Income taxes

The corporation follows the practice of providing for income taxes based on accounting income for tax purposes included in the financial statements regardless of when such income is subject to taxes under the tax laws. The corporation accounts for investment tax credits by the flow-through method.

g) Inventories

Inventories are valued at the lower of cost (calculated generally on a first-in, first-out basis) and net realizable value. The costs of finished goods and work in process comprise material, labor, and manufacturing overhead.

h) Goodwill

Goodwill represents the unamortized excess of the acquisition costs over the net assets of subsidiary companies at the dates of their acquisition and is amortized over periods not exceeding 40 years. Amortization charged to operations for the years ended December 31, 1983 through 1981 was $0.7, $0.7, and $0.6, respectively.

2. Accounting change–translation of foreign currencies

Effective January 1, 1983, the corporation changed its method of accounting for translation of foreign currencies to conform with new recommendations issued by The Canadian Institute of Chartered Accountants. The change has been applied retroactively and, accordingly, unrealized net gains on the translation of self-sustaining foreign subsidiaries for years prior to 1983 have been reclassified within shareholders' equity from retained earnings to foreign exchange adjustment (note 14). The amounts reallocated from retained earnings at December 31, 1982, 1981, and 1980 are $36.1, $17.3, and $9.8, respectively. Foreign exchange adjustment also includes the net effect of restatement of non-monetary assets and liabilities of self-sustaining foreign subsidiaries.

With the retroactive adoption of the new accounting method, all comparative figures shown in the financial statements have been restated. As a result, consolidated net earnings for the years ended December 31, 1982 and 1981 have been reduced by $18.8 and $7.5, respectively.

3. Difference between Canadian and United States generally accepted accounting principles–extraordinary item

The extraordinary gain of $16 ($0.15 per share) in 1981, described in note 6, does not meet the criteria for an extraordinary item under United States practice; consequently that amount would have increased earnings before extraordinary item for that year. Net earnings and earnings per share are identical under both Canadian and United States reporting practices.

4. Research and development

Research and development costs for the years ended December 31, 1983, 1982, and 1981 amounted to $390.3, $306.8, and $238.7, respectively. These costs include research and development charged to customers of Bell-Northern Research Ltd., principally Bell Canada, an affiliate of NTL, and costs expended pursuant to specific contracts for the manufacture of telecommunications equipment which are accounted for as contract costs. The net expense of research and development to the corporation for the years ended December 31, 1983 through 1981 amounted to $324.8, $241.4, and $181.6, respectively.

5. Provision for income taxes

Following is a reconciliation of income taxes calculated at the Canadian statutory rate to the provision for income taxes included in the consolidated statement of operations:

	1983	1982	1981
Income taxes at Canadian statutory rate including provincial income taxes	**$155.4**	$ 94.5	$ 75.2
Reduction of Canadian taxes applicable to:			
Manufacturing profits	**(1.4)**	(2.6)	(1.4)
Research and development incentives	**(34.4)**	(7.4)	(13.4)
Inventory allowance	**(3.9)**	(3.3)	(3.6)
Difference between Canadian statutory rate and rates applicable to foreign subsidiaries	**(12.1)**	(25.7)	(36.1)
Tax effect of losses of foreign subsidiaries not recognized	**—**	.7	10.8
Other	**(5.6)**	4.2	4.3
Provision for income taxes	**$ 98.0**	$ 60.4	$ 35.8

Details of the corporation's income taxes are:

	1983	1982	1981
Earnings before income taxes and extraordinary items			
Canadian	**$122.1**	$ 61.4	$ 53.7
Foreign	**203.0**	131.4	95.3
	$325.1	$192.8	$149.0
Provision for income taxes			
Canadian	**$ 43.8**	$ 24.2	$ 16.8
Foreign	**54.2**	36.2	19.0
	$ 98.0	$ 60.4	$ 35.8
Provision for income taxes			
Current	**$ 64.7**	$ 79.5	$ 48.4
Deferred	**33.3**	(19.1)	(12.6)
	$ 98.0	$ 60.4	$ 35.8

Deferred income taxes result principally from deductions for tax purposes in respect of plant and equipment being in excess of amounts currently charged to operations.

6. Extraordinary items

Extraordinary items for the year ended December 31 were:

	1983	1982	1981
Reduction of income taxes arising from the use of prior years' tax losses of a subsidiary company	**$41.3**	$ 7.0	$ —
Gain on sale of shares of Intersil, Inc. (proceeds $54.8 less book value of $18.9 and income taxes of $19.9)	**—**	—	16.0
	$41.3	$ 7.0	$16.0

7. Inventories

At December 31, inventories consisted of:

	1983	1982
Raw materials	**$256.1**	$192.0
Work in process	**263.1**	220.0
Finished goods	**153.6**	165.6
	$672.8	$577.6

8. Investments in non-consolidated finance subsidiaries

These subsidiaries provide funds to some of NTL's subsidiaries and finance certain equipment sales.

Following is a summary of the combined operations of the finance subsidiaries for the year ended December 31:

	1983	1982	1981
Interest income			
—NTL subsidiaries (net)	**$ 44.0**	$ 61.2	$ 68.8
—other	**27.7**	15.3	12.7
Rental and other income	**6.7**	3.6	26.6
Interest charges	**(11.9)**	(4.0)	(11.6)
Depreciation expense–leasebase	**—**	—	(21.2)
Administrative expenses	**(12.3)**	(7.1)	(4.2)
Earnings from operations	**54.2**	69.0	71.1
Foreign currency gains	**4.2**	—	—
Provision for income taxes	**(8.6)**	(12.0)	(12.1)
Net earnings	**$ 49.8**	$ 57.0	$ 59.0

Following is a summary of the combined assets and liabilities of the finance subsidiaries at December 31:

	1983	1982
Assets		
Cash and short-term investments	**$ .3**	$ 62.3
Receivables	**240.8**	139.6
Loans to NTL subsidiaries	**315.2**	374.6
Other assets	**11.3**	7.5
	$567.6	$584.0
Liabilities and shareholders' equity		
Variable rate bank loans bearing interest at an average rate of 10.7%	**$ 7.6**	$ 21.0
13⅜% note payable (U.S. dollars) due April 4, 1984	**—**	12.3
7% Convertible subordinated debentures (U.S. dollars) due December 1, 1997	**—**	98.3
due March 1, 1998	**54.8**	—
Other liabilities	**84.6**	30.1
Shareholders' equity (including foreign exchange adjustment of $18.1 in 1983, $16.1 in 1982)	**420.6**	422.3
	$567.6	$584.0

On December 1, 1982, Northern Telecom International Finance B.V. (NTIF) issued US$80 of seven percent convertible subordinated debentures due December 1, 1997. The debentures were convertible into common shares of NTL at US$24.3333 per share. Effective November 23, 1983, NTIF called for redemption all of the outstanding 1997 debentures at a price of US$1,073.44 per $1,000 principal, which included accrued interest and a four percent premium. During the year ended December 31, 1983, virtually all debentures were converted (note 13).

On March 1, 1983, NTIF issued US$50 of seven percent convertible subordinated debentures due March 1, 1998, which are unconditionally guaranteed on a subordinated basis by NTL. The debentures are convertible into common shares of NTL at US$29.6666 per share. At December 31, 1983, US$6 principal amount of debentures had been converted (note 13). The holders of the remaining outstanding debentures have the right to tender on March 1, 1985 or March 1, 1986 for redemption at 100 percent of the principal amount. Prior to March 1, 1986, NTIF has the right to call for redemption the outstanding 1998 debentures if the market price of NTL common shares is at least 120 percent of the conversion price for a specified period.

Receivables of $240.8 as at December 31, 1983 included $65.3 of notes and accounts receivable and the following amounts due to finance subsidiaries under non-cancellable leases:

	Direct financing leases
Year ended December 31	
1984	$ 49.9
1985	44.0
1986	39.8
1987	25.5
1988	17.4
Thereafter	73.6
	250.2
Less: unearned income	(74.7)
	$175.5

9. Plant and equipment

At December 31, plant and equipment consisted of:

	1983	1982
Cost		
Land	**$ 28.8**	$ 25.6
Buildings	**276.7**	199.0
Machinery and equipment	**975.0**	782.6
Equipment for lease to customers	**125.7**	123.8
Property under capital leases	**26.1**	28.5
	1,432.3	1,159.5
Less: Accumulated depreciation and amortization		
Buildings	**64.4**	54.3
Machinery and equipment	**458.5**	387.4
Equipment for lease to customers	**96.7**	92.1
Property under capital leases	**9.1**	9.3
	628.7	543.1
	$ 803.6	$ 616.4

10. Scientific Research Investment Contracts

In January 1982, NTL and a subsidiary concluded arrangements with investors to fund a portion of 1982 research and development expenditures. The subsidiary received $70 in cash in exchange for an obligation to make eight semi-annual and variable royalty payments commencing June 30, 1983, based on the corporation's worldwide telecommunications revenues. The arrangements provide for the investors to treat their investment as research and development for tax purposes and thus research and development income tax incentives in respect of the expenditure were available to the investors and not to the corporation. In 1981, $20 was received under similar arrangements.

At December 31, 1983, estimated payments under these contracts for the years 1984 through 1986 amounted to $24.5, $23.8 , and $11.9, respectively.

11. Long-term debt

	1983	1982
Sinking fund debentures		
7¼% Series C due April 15, 1986	**$ 1.2**	$ 1.2
10½% Series D due April 30, 1990	**12.6**	12.6
	13.8	13.8
Fixed rate bank loans of a U.S. subsidiary (U.S. dollars) bearing interest at an average rate of 10.7%	**7.6**	–
Variable rate revolving bank loans of European subsidiaries (various currencies) bearing interest at an average rate of 12.5%	**10.1**	12.1
Variable rate term loan (U.S. dollars) due on December 20, 1985 (prepaid on March 30, 1983)	–	30.7
12¼% Notes (U.S. dollars) due October 1, 1990	**73.3**	86.2
9¼% Subordinated notes (U.S. dollars) due June 30, 1989	–	30.7
12¼% Subordinated convertible notes (U.S. dollars) due December 1, 1993	–	61.4
Obligations under capital leases	**21.7**	22.6
Other	**4.1**	.6
	130.6	258.1
Less: amount included in current liabilities	**(3.3)**	(13.5)
	$127.3	$244.6

On June 30, 1982, NTL sold privately US$25 of 9¼ percent subordinated notes maturing June 30, 1989 with warrants to purchase common shares at US$15.42 per share. On February 17, 1983, against surrender of these notes, the holder exercised warrants attached thereto and purchased 1,500,000 common shares (note 13) and received a cash payment of US$1.875.

On March 7, 1983, holders converted US$50 of 12¼ percent subordinated convertible notes due December 1, 1993 into 2,439,021 common shares at the conversion price of US$20.50 per share (note 13).

At December 31, 1983, the amounts of long-term debt payable, including net sinking fund requirements, for the years 1984 through 1988 were $3.3, $13.1, $2, $0.8, and $1, respectively.

Following is an analysis of interest charges on long-term debt as shown in the consolidated statement of operations:

	1983	1982	1981
Interest charges on long-term debt of NTL and consolidated subsidiaries	**$ 60.4**	$ 95.8	$112.2
Less: equity in earnings from operations of non-consolidated finance subsidiaries (note 8)	**(54.2)**	(69.0)	(71.1)
	$ 6.2	$ 26.8	$ 41.1

12. Unused bank lines of credit

At December 31, 1983, NTL and certain subsidiary companies had unused bank lines of credit, generally available at the prime bank rate of interest, of approximately $289.

13. Share capital

The authorized share capital of the corporation consists of an unlimited number of common shares without nominal or par value and an unlimited number of Class A Preferred Shares and of Class B Preferred Shares without nominal or par value, with the consideration to be determined by the Board of Directors for the issue of any of such shares. The preferred shares were authorized in 1982; no preferred shares have been issued to date. At December 31, 1983, Bell Canada Enterprises Inc. (BCE) owned 51.9 percent of the outstanding common shares of the corporation. Comparative number of shares and per share figures provided have been restated to reflect the three-for-one subdivision of the common shares of the corporation issued or reserved for issuance, which became effective on May 11, 1983.

Outstanding common shares and stated capital were:

	1983		1982	
	Shares	Stated capital	Shares	Stated capital
January 1	**106,352,286**	**$524.4**	104,842,632	$496.7
Issued during the year	**8,254,936**	**231.3**	1,509,654	27.7
December 31	**114,607,222**	**$755.7**	106,352,286	$524.4

Common shares issued and reserved for issuance were:

	1983	1982	Issued 1981	Reserved at December 31, 1983 for issuance
Shareholder Dividend Reinvestment and Stock Purchase Plan	**630,671**	1,117,647	1,379,679	**2,602,342**
Investment Plan for Employees –Canada	**176,155**	372,921	164,589	**1,236,335**
Employee Thrift/Savings Plan–U.S. (effective January 1982)	**20,703**	19,086	–	**710,211**
Warrants expiring June 30, 1989 (note 11)	**1,500,000**	–	–	–
12¼% Subordinated convertible notes due December 1, 1993 (note 11)	**2,439,021**	–	–	–
7% Convertible subordinated debentures issued by NTIF (note 8) due December 1, 1997	**3,286,649**	–	–	–
due March 1, 1998	**201,737**	–	–	**1,483,654**
	8,254,936	1,509,654	1,544,268	**6,032,542**

14. Foreign exchange adjustment

Following is an analysis of the foreign exchange adjustment included in shareholders' equity at December 31:

	1983	1982	1981
Balance at beginning of year	**$37.4**	$15.7	$22.2
Translation adjustments	**5.6**	27.8	(7.7)
Gains (losses) on hedges	**(.6)**	(6.1)	1.2
Balance at end of year	**$42.4**	$37.4	$15.7

15. Cash provided by changes in working capital

Changes in the components of working capital excluding cash and short-term investments for the year ended December 31 were:

	1983	1982	1981
(Increase) decrease in			
Accounts receivable	**$(199.1)**	$(44.3)	$(87.6)
Inventories	**(95.2)**	33.9	(59.3)
Prepaid expenses	**.5**	(1.6)	.6
Tax benefit of loss carryforward	**–**	–	12.7
Deferred income taxes	**(7.0)**	(12.2)	13.2
Increase (decrease) in			
Accounts payable and accrued liabilities	**181.2**	91.1	46.8
Taxes payable	**(4.1)**	22.7	36.6
Cash provided by (applied to) changes in working capital	**$(123.7)**	$ 89.6	$(37.0)

16. Plans for employees' pensions

NTL and most of its subsidiary companies have non-contributory defined benefit plans which provide for service pensions based on length of service and rates of pay for substantially all their employees.

The policy is to fund pension costs based on various actuarial cost methods as permitted by pension regulatory bodies. Such costs are funded as accrued and reflect actuarial assumptions regarding salary projections. Pension costs charged to earnings for the years ended December 31, 1983, 1982, and 1981 were $67.6, $64.7, and $52.2, respectively, which included costs associated with voluntary payments for retired employees.

In compliance with the United States Financial Accounting Standards Board's Statement No. 36, the disclosure of the following information is required to exclude actuarial assumptions regarding salary projections. A comparison of accumulated plan benefits and plan net assets follows:

January 1	**1983**	1982
Actuarial present value of accumulated plan benefits		
–vested	**$559.4**	$486.1
–non-vested	**27.3**	20.2
	$586.7	$506.3
Net assets available for benefits, at market value	**$768.0**	$592.2

The weighted average assumed rate of return used in determining the actuarial present value of accumulated plan benefits was eight percent for both 1983 and 1982.

17. Leased property and commitments

At December 31, 1983, future minimum lease payments under capital leases, net of estimated executory costs and imputed interest, amounted to $21.7 and future minimum payments under operating leases were $99.7.

Rental expense on operating leases amounted to $50.4, $45, and $31.1, for the years ended December 31, 1983, 1982, and 1981, respectively.

18. Information on business segment by geographic areas

Business segment

NTL operates in one business segment–telecommunications equipment, which consists of the design, development, manufacture, and marketing of central office switching equipment, business communications systems, transmission equipment, cable and outside plant products, terminal equipment, and other telecommunications products and services.

Geographic areas

The following table sets forth information by geographic area for the year ended December 31:

	1983	1982	1981
Total revenues			
Canada			
Customers	**$1,252.2**	$1,392.3	$1,334.6
Transfers between geographic areas	**520.2**	249.9	160.2
	1,772.4	1,642.2	1,494.8
United States			
Customers	**1,886.6**	1,473.4	1,047.0
Transfers between geographic areas	**65.9**	93.8	85.3
	1,952.5	1,567.2	1,132.3
Other			
Customers	**165.2**	169.8	189.3
Transfers between geographic areas	**19.7**	17.1	15.5
	184.9	186.9	204.8
Elimination of transfers between geographic areas	**(605.8)**	(360.8)	(261.0)
Total customer revenues	**$3,304.0**	$3,035.5	$2,570.9

Operating earnings			
Canada	**$ 388.3**	$ 357.1	$ 324.9
United States	**368.5**	182.1	110.4
Other	**26.9**	36.9	30.7
Adjustments and eliminations	**–**	(.4)	(1.0)
Operating earnings before research and development expense	**783.7**	575.7	465.0
Research and development expense	**(324.8)**	(241.4)	(181.6)
Segment operating earnings	**458.9**	334.3	283.4
General corporate expenses	**(152.4)**	(126.3)	(100.6)
Operating earnings	**306.5**	208.0	182.8
Non-operating expenses less other income	**18.6**	(15.2)	(33.8)
Earnings before income taxes and extraordinary items	**$ 325.1**	$ 192.8	$ 149.0
Identifiable assets			
Canada	**$1,206.5**	$ 952.9	$ 815.3
United States	**1,273.9**	1,084.9	839.4
Other	**192.0**	175.2	153.0
Adjustments and eliminations	**(459.2)**	(416.0)	(91.2)
Identifiable assets	**2,213.2**	1,797.0	1,716.5
Investments	**433.0**	433.1	359.2
Corporate assets	**226.8**	213.3	70.1
Total assets as at December 31	**$2,873.0**	$2,443.4	$2,145.8

Transfers between geographic areas are made at prices based on total cost of the product to the supplying segment.

The point of origin (the location of the selling organization) of revenues and the location of the assets determine the geographic areas.

Of the total customer revenues, including research and development, revenues from Bell Canada and other subsidiaries and associated companies of BCE accounted for $798.9, $913.8, and $911.7 for 1983, 1982, and 1981, respectively. Total revenues also include rental and service revenue of $181.4, $186.8, and $163.8 for 1983, 1982, and 1981, respectively.

Operating earnings represent total revenues less operating expenses. Research and development costs cannot be allocated on a geographic basis. In computing operating earnings, none of the following items has been added or deducted: investment and other income (net), interest charges, currency gains (losses), general corporate expenses, income taxes, and extraordinary items.

Identifiable assets are those assets of the corporation that are identified with the operations in the geographic area. Corporate assets are principally cash and short-term investments, and corporate plant and equipment.

Finance subsidiaries are not consolidated (see notes 1 and 8).

Auditors' Report

The Shareholders
Northern Telecom Limited

We have examined the consolidated balance sheets of Northern Telecom Limited as at December 31, 1983 and 1982 and the consolidated statements of operations, retained earnings and changes in financial position for each of the three years in the period ended December 31, 1983. Our examinations were made in accordance with generally accepted auditing standards, and accordingly included such tests and other procedures as we considered necessary in the circumstances.

In our opinion, these consolidated financial statements present fairly the financial position of the corporation as at December 31, 1983 and 1982 and the results of its operations and the changes in its financial position for each of the three years in the period ended December 31, 1983 in accordance with Canadian generally accepted accounting principles applied, after giving retroactive effect to the change, which we approve, in the method of accounting for foreign currency translation, as described in note 2, on a consistent basis.

Touche Ross & Co.

Chartered Accountants

Toronto, Ontario
Canada
February 3, 1984

Consolidated supplementary information on the effects of changing prices

(unaudited)

Northern Telecom's financial statements are prepared on the historical cost basis in accordance with accounting principles generally accepted in Canada. Inflation erodes the value of capital, increasing the costs of maintaining current levels of business activity and, especially, of replacing plant and equipment. The effects of changes in the value of money, whether measured in terms of general price levels or in terms of costs specific to a particular enterprise, are not apparent in historical cost accounts. In an attempt to separate those effects from the economic impact of changes in levels of business activity, The Canadian Institute of Chartered Accountants (CICA) has recommended the presentation of certain supplementary financial data based on current costs and such information is shown below.

The CICA current cost recommendations are essentially experimental. Generally, current costs are based on estimates; there are many different asset valuation methods and the selection of appropriate methods by individual companies is a subjective process. Consequently, the reader is advised to exercise caution in interpreting the information presented. In particular, it is not recommended that the data be used in isolation for purposes of valuing the corporation in terms of its assets or traditional financial ratios. In addition, because of the subjectivity inherent in the formulation of the data, intercompany comparisons of current cost results, even within an industry, may not be reliable.

Current cost information presented

The supplementary data focus principally on the representation of operating costs and asset values based on current reproduction or replacement costs. Generally, the accounting policies outlined in the historical cost financial statements are followed in the preparation of the current cost data. Only inventories and plant and equipment are revalued as these are the significant assets by reference to which the corporation's operating capability may be assessed. The revaluation has two purposes: to provide an estimate of the costs of reproducing or replacing assets in such a way that the present level of activity is unchanged and to reflect an adjusted cost of revenues and depreciation expense based on the revalued amounts as if the assets had actually been reproduced or replaced at these values.

Consolidated statement of operations on a current cost basis

Year ended December 31
(millions of dollars)

	1983	1982*
Earnings before income taxes and extraordinary items (historical cost)	**$325.1**	$203.9
Less: current cost adjustments		
Cost of revenues (note A)	**(5.8)**	12.4
Depreciation expense (note B)	**19.5**	25.7
Loss on disposal of plant and equipment (note C)	**(10.8)**	(8.9)
	2.9	29.2
Current cost earnings before income taxes and extraordinary items	**322.2**	174.7
Provision for income taxes (note D)		
Current	**64.7**	84.1
Deferred	**33.3**	(20.2)
	98.0	63.9
Current cost net earnings before extraordinary items	**$224.2**	$110.8

*The 1982 comparative amounts have been restated in (approximatley) 1983 average dollar values.

Schedule of significant items on a current cost basis

As at December 31
(millions of dollars)

	1983	1982**
Inventories (note A)	**$ 672.1**	$ 618.9
Plant and equipment (note B)	**$ 971.1**	$ 812.1
Shareholders' equity (net assets) (note E)	**$1,627.7**	$1,234.6

**The 1982 comparative amounts have been restated in 1983 yearend dollars.

Harmony, Northern Telecom's new electronic residential telephone, is available in an array of decorative colors. Harmony requires 10 minutes to produce compared with 30 minutes for older types of telephones.

Notes to the current cost information

A. The cost of revenues adjustment reflects the general movement in the costs of manufacturing inputs between the dates of their purchase or application to manufacturing processes and the dates of sale of the related finished products. Inventories on hand at the yearend are revalued at the costs of manufacturing inputs prevailing at that date. The calculations are based on indices generated as part of the ongoing management control process.

B. The depreciation expense adjustment represents the excess of depreciation based on current costs over depreciation based on historical costs. Plant and equipment are revalued at their costs of reproduction or replacement at the yearend, based on appraisals or industry indices prepared specially for the purpose.

C. Losses on disposal of plant and equipment, deducted in arriving at historical cost earnings, do not arise in current cost accounting because the current values of assets disposed of are adjusted at the disposal dates to equal the disposal proceeds.

D. No adjustment is made to income tax expense. This is in conformity with the CICA recommendations, although it should be recognized that additional tax deductions would be available if the estimated current costs were in fact actual costs.

E. Shareholders' equity has been adjusted by $4.6 ($ nil for 1982) in respect of the minority interest in the increase in the current cost of assets.

Other supplementary information

Year ended December 31
(millions of dollars)

The following information includes a restatement of selected items to reflect the effects of general inflation as measured by the Consumer Price Index. This is designed to provide an indication of the relationship of price level changes specific to the corporation's assets to price level changes in the economy as a whole.

	1983	1982*
Increase (decrease) in the current cost of inventories and plant and equipment held during the year	**$ (9.0)**	$ 57.0
Effect of general inflation	**60.8**	128.2
Excess of effect of general inflation over the change in current cost	**$69.8**	$ 71.2

During periods of inflation, a corporation with a net monetary liability position benefits from a gain in its purchasing power. As the value of money decreases, so too does the real amount of the net monetary liabilities.

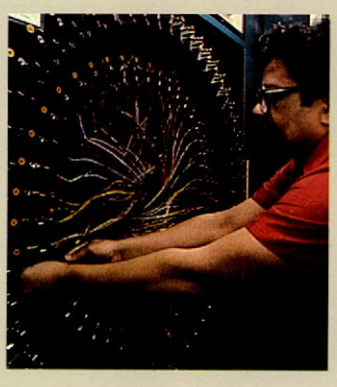
	1983	1982*
Gain in general purchasing power from holding net monetary liabilities during the year	**$3.1**	$22.2

The above data for 1983 show that if the corporation had actually financed the change in the current cost of its operating assets while leaving its present manufacturing capacity unchanged, there would have been a cash inflow of $9. The decrease in current costs is attributable to cost reductions and technology. As the corporation is capitalized partially by shareholders' equity and partially by debt, it is reasonable to assume that in the long run the cash provided by the reproduction or replacement of the operating assets would be for the account of the shareholders or debtholders in their existing proportions. The financing adjustment represents the amount which would be applied to debt and is deducted in computing the year's increase in shareholders' equity on a current cost basis. In 1982, there was an increase of $57 in the current cost of operating assets and if the corporation had actually reproduced or replaced these assets, a portion of the funds required would have been provided by debt.

	1983	1982*
Financing adjustment, being increase (decrease) in earnings attributable to the shareholders	**$(.4)**	$9.3

The financing adjustment based on the current cost adjustments in the consolidated statement of operations on a current cost basis amounts to $0.1 ($4.8 for 1982).

*The 1982 comparative amounts have been restated in (approximately) 1983 average dollar values.



Joy Pannakal applies electrical current to test the quality of telephone cable wires manufactured at Northern Telecom Canada Limited's Kingston, Ontario plant.

Consolidated 11-year review

Northern Telecom Limited and subsidiary companies
(millions of dollars)

		1983	1982*	1981*
Earnings and related data	Revenues	**$3,304.0**	$3,035.5	$2,570.9
	Cost of revenues	**2,112.0**	2,124.2	1,847.2
	Depreciation on plant and equipment	**156.0**	175.0	120.7
	Selling, general and administrative expenses	**560.7**	461.9	359.3
	Research and development expense	**324.8**	241.4	181.6
	Interest charges	**10.6**	39.6	64.2
	Provision for income taxes*	**56.7**	53.4	55.7
	Earnings (loss) before extraordinary items**	**227.1**	132.4	113.2
	Net earnings (loss)	**268.4**	139.4	129.2
	Earnings (loss) per revenue dollar (cents)	**8.1**	4.6	5.0
	Earnings (loss) per share (dollars)			
	—before extraordinary items	**2.05**	1.26	1.09
	—after extraordinary items	**2.42**	1.32	1.24
	Dividends per share (dollars)	**0.40**	0.33	0.33
Financial position at December 31	Working capital	**701.5**	636.1	498.1
	Plant and equipment (at cost)	**1,432.3**	1,159.5	983.7
	Accumulated depreciation	**628.7**	543.1	420.8
	Total assets	**2,873.0**	2,443.4	2,145.8
	Long-term debt***	**127.3**	244.6	246.0
	Shareholders' equity	**1,465.5**	1,005.5	851.8
	Capital expenditures	**376.9**	252.6	209.6
Compensation	Payroll	**1,155.9**	1,033.9	847.7
	Benefits	**218.6**	192.3	144.2
	Total	**$1,374.5**	$1,226.2	$ 991.9
	Employees at December 31	**39,318**+	34,449+	35,444+

*Restated–see note 2. Amounts prior to 1977 have not been restated. The changes were not material.
+Excludes employees of associated Turkish company, NETAS–Northern Electric Telekomünikasyon A.S.
*Includes income tax effects of extraordinary items.

**If the extraordinary items had been classified in accordance with U.S. generally accepted accounting principles, the earnings (loss) before extraordinary items in 1981 and 1980, would have been $129.2 and ($185.1).
***Excludes long-term debt of non-consolidated finance subsidiaries incorporated in 1978 and 1979.

Quarterly financial data (unaudited)

Summarized consolidated quarterly financial data for 1983 and 1982 are as follows:

(millions of dollars except per share figures)

	4th Quarter		3rd Quarter		2nd Quarter		1st Quarter	
	1983	1982*	**1983**	1982*	**1983**	1982*	**1983**	1982*
Revenues	**$974.2**	$788.1	**$739.5**	$739.5	**$816.3**	$790.8	**$774.0**	$717.1
Gross profit	**$352.8**	$262.7	**$278.3**	$221.0	**$302.6**	$218.2	**$258.3**	$209.4
Earnings before extraordinary items	**$ 67.8**	$ 43.5	**$ 49.5**	$ 28.0	**$ 62.4**	$ 27.6	**$ 47.4**	$ 33.3
Net earnings	**$ 84.5**	$ 48.3	**$ 57.9**	$ 30.2	**$ 71.0**	$ 27.6	**$ 55.0**	$ 33.3
Earnings per share								
—before extraordinary items	**$ 0.60**	$ 0.41	**$ 0.44**	$ 0.26	**$ 0.56**	$ 0.26	**$ 0.44**	$ 0.32
—after extraordinary items	**$ 0.74**	$ 0.46	**$ 0.52**	$ 0.29	**$ 0.64**	$ 0.26	**$ 0.51**	$ 0.32
Weighted average number of common shares outstanding (thousands)	**113,446**	106,120	**111,743**	105,708	**110,669**	105,255	**107,775**	104,877

*Restated–see note 2 of Notes to consolidated financial statements

1980*	1979*	1978*	1977*	1976	1975	1974	1973
$2,054.6	$1,900.5	$1,504.6	$1,221.9	$1,083.5	$ 996.8	$ 957.7	$ 608.1
1,553.7	1,303.4	1,032.1	873.2	781.4	725.5	716.3	448.6
113.9	91.1	53.4	30.9	24.1	23.3	25.4	16.2
341.5	280.0	229.0	159.2	122.4	100.4	92.6	65.6
140.9	132.6	97.8	68.2	61.4	49.0	44.0	32.7
44.9	38.2	17.1	6.6	6.8	8.3	7.7	6.5
4.3	35.5	36.7	44.9	48.0	44.7	49.6	30.5
(21.3)	111.2	87.7	80.9	73.9	70.2	53.8	32.0
(185.1)	111.2	94.0	84.4	77.1	67.5	53.8	32.0
(9.0)	5.9	6.2	7.0	7.1	6.8	5.6	5.3
(0.21)	1.21	1.03	1.02	0.93	0.88	0.68	0.45
(1.83)	1.21	1.11	1.06	0.97	0.85	0.68	0.45
0.33	0.28	0.25	0.22	0.20	0.20	0.18	0.17
456.2	557.1	370.4	337.1	307.6	284.9	281.4	209.7
852.2	702.8	615.9	393.0	360.1	287.2	273.4	257.3
345.9	277.2	234.5	204.3	189.2	164.2	156.6	141.3
1,998.9	1,889.5	1,356.4	764.2	674.8	570.4	555.2	494.3
321.7	192.0	190.5	52.6	58.3	67.8	104.5	69.6
740.7	922.1	643.3	472.4	400.8	339.9	285.2	245.0
225.6	173.5	127.2	44.7	38.2	31.7	33.2	26.3
730.2	651.8	482.9	395.3	347.2	325.0	301.2	214.1
131.5	108.1	93.3	75.0	58.0	45.0	41.2	35.1
$ 861.7	$ 759.9	$ 576.2	$ 470.3	$ 405.2	$ 370.0	$ 342.4	$ 249.2
31,915+	33,301+	31,756+	24,962	25,277	23,751	26,147	25,073

Principal products

Business communications
Data packet switching networks
Basic and featured electronic key telephone systems
Electronic and digital PBX systems (combined voice and data)
Private and carrier network switching systems

Information processing equipment
On-line terminal systems
Data entry terminal systems
Distributed data processing systems
Remote batch terminal systems
Integrated voice and data terminals

Subscriber apparatus
Rotary dial, push-button and key telephones
Electronic and featured telephones
Style, decorator, and novelty telephones
Coin telephones
Hands-free speaker units
Repertory dialers
Modular hardware
Headsets
Specialty and accessory terminals

Cable
Telephone wires
Composite coaxial cables
Switchboard wires and cables
Pulp and paper ribbon insulated telephone cables
Polyolefin insulated telephone cables
Frame wires
PVC insulated inside wiring cables

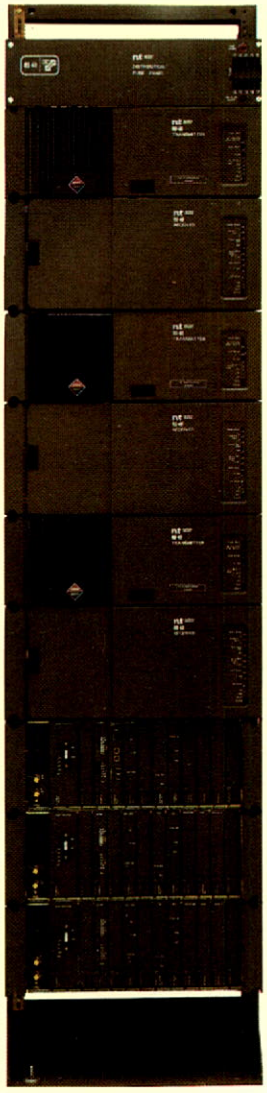
Outside plant
Customer premises distribution systems
Central office protectors and connectors
Subscriber protection devices
Terminals and closures
Splicing connectors
Loading devices
Outdoor cross connect systems

Test equipment
Transmission test equipment
Signaling and supervision test equipment
Service observation test equipment
Service analysis equipment
PCM carrier test equipment
Loop test equipment
Trunk test equipment
Data communications diagnostic test equipment
Data communications patching and switching equipment
Data communications remote access switching and patching equipment

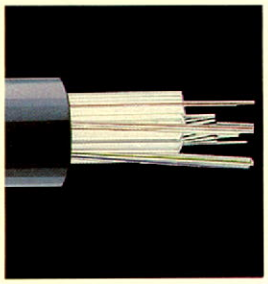
Central office switching
Step-by-step systems
Crossbar switching systems
Electronic switching systems
Digital switching systems
Traffic Operator Position Systems
Centralized Automated Loop Reporting Systems
Peripheral systems

Power equipment
Power plants
Ringing and tone equipment

Transmission
Analog and digital carrier systems
Analog and digital multiplex systems
Analog and digital microwave radio systems
Voice frequency equipment and systems
Digital line transmission systems
Optical fiber transmission systems
Private network transmission systems
Special subscriber services



RD-4A digital microwave radio



Optical fiber cable

Trademarks
The names *Digital World, Displayphone, DMS, Flashback, Harmony, Mercury, OPEN World, PROTEL, Pulse, RAPID, RD-4A, SL, TOPS,* and *Vantage,* used in this report, are trademarks of Northern Telecom Limited.

Corporate offices

Northern Telecom Limited
Corporate Executive Offices
33 City Centre Drive
Mississauga, Ontario
L5B 3A2
Telephone:
(416) 275-0960
Telex: 06-960-348

Bell-Northern Research Ltd.
3500 Carling Avenue
Ottawa, Ontario
K1Y 4H7
Telephone:
(613) 596-2210
Telex: 053-3175

BNR Inc.
685A East
Middlefield Road
Mountain View,
California 94043
Telephone:
(415) 969-9170
Telex: 334-414

Northern Telecom AG
Drahtzugstrasse 18
8008 Zurich,
Switzerland
Telephone:
(41) (1) 55 70 20
Telex: 59640

Northern Telecom (Asia) Limited
Uol Building
10th Floor
96 Somerset Road
Singapore 0923
Telephone:
(65) 7379133
Telex: 23369

Northern Telecom (CALA) Corporation
14701 N.W.
77th Avenue
Miami Lakes, Florida
33014
Telephone:
(305) 558-4858
Telex: 515678

Northern Telecom Canada Limited
304 The East Mall
Islington, Ontario
M9B 6E4
Telephone:
(416) 232-2000
Telex: 06-984-607

Northern Telecom Data Systems Limited
Maylands Avenue
Hemel Hempstead,
Hertfordshire
England
HP2 7LD
Telephone:
(44) (442) 41141
Telex: 826151

Northern Telecom (Dublin) Limited
25 St. Stephen's Green
Dublin 2, Republic of Ireland
Telephone:
(353) (1) 609488
Telex: 31673

Northern Telecom Electronics Limited
33 City Centre Drive
Mississauga, Ontario
L5B 3A2
Telephone:
(416) 275-0960
Telex: 06-960-348

Northern Telecom France S.A.
185, avenue
Charles-de-Gaulle
F-92200
Neuilly-sur-Seine,
France
Telephone:
(33) (1) 722-5151
Telex: 611819

Northern Telecom Inc.
259 Cumberland Bend
Nashville, Tennessee
37228
Telephone:
(615) 256-5900
Telex: 554368

Northern Telecom Industries Sdn. Bhd.
Bayan Lepas
Free Trade Zone,
Penang,
West Malaysia
Telephone:
(60) (4) 831-211
Telex: 40056

Northern Telecom International Inc.
259 Cumberland Bend
Nashville, Tennessee
37228
Telephone:
(615) 256-5900
Telex: 554368

Northern Telecom International Limited
33 City Centre Drive
Mississauga, Ontario
L5B 3A2
Telephone:
(416) 275-0960
Telex: 06-960-348

Northern Telecom (Ireland) Limited
Industrial Estate
Galway
Republic of Ireland
Telephone:
(353) (91) 57671
Telex: 28343

Northern Telecom (Middle East) Limited
Langton House
Market Street
Maidenhead,
Berkshire
England
SL6 8BE
Telephone:
(44) (628) 35031
Telex: 849846

Northern Telecom plc
Berkeley Square House
Berkeley Square
London W1X 5LE
England
Telephone:
(44) (1) 491 4599
Telex: 27433

Northern Telecom (U.K.) Limited
Langton House
Market Street
Maidenhead,
Berkshire
England
SL6 8BE
Telephone:
(44) (628) 72921
Telex: 849725

Listing of stock

Montreal Exchange
New York Stock Exchange
The Toronto Stock Exchange
Vancouver Stock Exchange

Stock symbols
NT on NYSE
NTL on Montreal, Toronto, and Vancouver exchanges

Dividend Reinvestment and Stock Purchase Plan

Shareholders wanting to purchase additional shares of Northern Telecom Limited can take advantage of a convenient and cost-free investment plan. Quarterly dividends may be invested automatically to purchase additional shares at a discount from the average market price (calculated during a fixed period each quarter). Shares may also be purchased at the average market price by voluntary cash payments of as little as $50 to a maximum of $5,000 during a quarter. In either case, there are no brokerage fees or other service charges. Additional information may be obtained from:
The Treasurer
Northern Telecom Limited
P.O. Box 6121,
Station A
Montreal, Quebec
Canada H3C 3A7

Transfer offices

Corporate offices
800 Place Victoria
Suite 250
Montreal, Quebec
H4Z 1A2

483 Bay Street
Floor 2, South Tower
Toronto, Ontario
M5G 2E1

Montreal Trust Company
Halifax, Winnipeg, Regina, Calgary, Vancouver
Manufacturers Hanover Trust Company
New York, New York
Continental Illinois National Bank and Trust Company of Chicago
Chicago, Illinois

Registrars

Montreal Trust Company
Halifax, Montreal, Toronto, Winnipeg, Regina, Calgary, Vancouver
Manufacturers Hanover Trust Company
New York, New York
Continental Illinois National Bank and Trust Company of Chicago
Chicago, Illinois

Northern Telecom Limited
Corporate executive offices
33 City Centre Drive
Mississauga, Ontario L5B 3A2

Printed in Canada